NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

APPLYING TECHNOLOGY TO MARINE CORPS DISTANCE LEARNING

by

Michael G. Broihier

September, 1997

Thesis Advisor:	Alice M. Crawford
Co-Advisor:	Hemant Bhargava

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE SEPTEMBER, 1997	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE APPLYING TECHNOLOGY TO MARINE CORPS DISTANCE LEARNING	5. FUNDING NUMBERS
6. AUTHOR(S) BROIHIER, MICHAEL, G.	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited	12b. DISTRIBUTION CODE

13. ABSTRACT The purpose of this thesis is to investigate the application of technology to distance learning with the intention of recommending to the Marine Corps a feasible migration path away from its current correspondence program. Currently, the Marine Corps Institute (MCI) administers correspondence courses for both Occupational Skill Development (OSD) and Professional Military Education (PME). Automating and streamlining MCI processes is insufficient considering the pivotal importance distance learning plays in a Marine's career. Current application of technology to distance learning in education, business, and the military is discussed in light of information obtained through interviews, site visits, conferences, and the literature. A non-exhaustive list of tangible and intangible costs and benefits related to various distance learning technologies is provided, as well as a template for a distance learning decision making process. The process can be used with decision support software to match requirements to technology and select appropriate migration paths through cost benefit analysis. This thesis recommends applying asynchronous methods to OSD courses and a combination of synchronous and asynchronous methods to PME courses. Finally, this thesis recommends changing the current structure and mission of MCI and consolidating its efforts with the College of Continuing Education under the Marine Corps University.

14. SUBJECT TERMS Distance Learning, CBT, Computer Based Training, VTT, Video Teletraining, Marine Corps Institute, MCI.	15. NUMBER OF PAGES 16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18
298-102

Approved for public release; distribution is unlimited.

APPLYING TECHNOLOGY TO MARINE CORPS DISTANCE LEARNING

Michael G. Broihier
Major, United States Marine Corps
B.A., Rutgers College, 1984

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September, 1997

Author: Michael G. Broihier

Michael G. Broihier

Approved by: Alice M. Crawford

Alice M. Crawford, Thesis Advisor

HKBhargava

Hemant Bhargava, Thesis Co-Advisor

Reuben T Harris

Reuben T. Harris, Chairman
Department of Systems Management

ABSTRACT

The purpose of this thesis is to investigate historical and state of the art application of technology to distance learning, and form a recommendation for the Marine Corps to do the same. Currently, the Marine Corps Institute (MCI) administers correspondence courses for both Occupational Skill Development (OSD) and Professional Military Education (PME). Attempts to automate and streamline MCI processes are insufficient considering the pivotal importance distance learning plays in a Marine's career. Current application of synchronous and asynchronous technologies to distance learning in education, business, government, and the military are discussed in light of information obtained through interviews, site visits, and conferences. A non-exhaustive list of tangible and intangible costs and benefits related to various distance learning technologies is provided, as well as a template for a distance learning decision making process. The process can be used in conjunction with training decision support software, like Advisor 2.0, to systematically match requirements to technology and select appropriate migration paths through cost benefit analysis. This thesis recommends applying asynchronous distance learning methods to OSD courses and a combination of asynchronous and synchronous methods to PME, as well as changing the current structure of MCI and consolidating its efforts with the College of Continuing Education under the Marine Corps University.

TABLE OF CONTENTS

I. INTRODUCTION

The first three of seven courses that comprise the Marine Corps Command and Staff College Nonresident Program are still in their box in the corner of my office. Weighing in at just over 24 pounds and bearing $9.20 worth of postage, the box hit the floor with a satisfying thump 9 months ago and hasn't moved since. The threat of never getting promoted again has yet to generate enough urgency to cause me to break open that box and work through 24 pounds of paper and the subsequent four courses.

A. BACKGROUND

Initiated in 1920 "...to permit World War I Marine veterans to complete interrupted education" (Heinl, 1977) the Marine Corps Institute (MCI) system of correspondence courses has grown into a factor of pivotal importance in a Marine's career. Currently servicing well over 50,000 Marines and other service members enrolled in courses per month, MCI produces and distributes two types of courses: Occupational Skill Development (OSD) that tend to be single lesson/single subject courses, and the far more complex Professional Military Education (PME) courses that are multi-lesson/multi-subject courses. Students receive printed materials, complete courses, and take exams all via mail.

B. PROBLEM

Before an officer can be selected for promotion to Lieutenant Colonel, that Marine must either attend the resident Command and Staff College, or complete the

correspondence course (ALMAR 206/97). Unfortunately, less than half of the officers eligible for the resident course are selected. The Navy Times reported that only 342 out of 726 majors will be selected to attend the resident career level schools on the FY-98 selection board, leaving most to pursue the course via correspondence (May, 1997). These nonresident PME courses were developed because not every Marine is available, or eligible, for resident instruction. For example, students who attend the Naval Postgraduate School (NPS) are ineligible to attend the Command and Staff College. Unfortunately, those Marines who are unavailable because of their duties (deployed Marines, recruiters, drill instructors) are in demanding billets and are the least likely to have the amount of free time demanded by the nonresident PME courses.

Over the years MCI has automated registration, test scoring and record keeping, but to this day, the method of instruction has not strayed from the traditional correspondence course method. Over the past 3 years "...more than 2000 officers have enrolled in (Command and Staff)...and only 126 have graduated." (Anderson, 3 February, 1997) At an estimated degree of effort of "3-hours-a-week ...for 2 ½ years" (Anderson, July 14, 1997) Command and Staff is MCI's largest and most demanding Professional Military Education course but is also representative of the distance learning challenges faced by Marines at many levels. At almost every rank from Lance Corporal to Gunnery Sergeant, and 1st Lieutenant to Major, a Marine will not be advanced, and therefore not retained in the service, if the appropriate level course is not completed. In the case of Noncommissioned officers (NCOs), attending the resident program does not fulfill the PME requirement for promotion (ALMAR 339/96) making the MCI course essential.

Recognizing that there is a looming problem with PME, the Commandant has marshaled the efforts of several offices, including the Marine Corps Modeling and Simulation Office (MCMSMO) to organize a deliberate, technology-centered effort to increase the quality of and access to PME. In the interim, the Marine Corps University (MCU), which authors and grades PME courses, has embraced technological solutions to attempt to "...ease the burden on the nonresident students." (Anderson, 3 February, 1997) They have constructed a frequently-asked-question (FAQ) site on the World Wide Web, and soon some lectures will be offered by video-teleconferencing (VTC) to major commands. These efforts will surely ameliorate some problems, however they are unfocused and symptom oriented.

C. PURPOSE AND RESEARCH QUESTIONS

1. Purpose

The purpose of this thesis is to describe a vision for Marine Corps distance learning that uses technology to mitigate historical weaknesses in effectiveness and efficiency. This paper is intended to assist the Marine Corps' efforts to increase the effectiveness of its distance learning program by examining the span of technology currently being used in distance learning and how it is applied, ascendant technologies, and the promise for return on investment. The focus is to explore current and ascending technologies being applied to distance learning and to establish metrics to gauge their cost effectiveness. Targeted for change will be non-Military Occupational Specialty (MOS) producing distance education courses, but there is no reason that some of the recommendations won't be applicable to other types of military training.

2. Research Questions

a. What current/future technologies are being applied to distance learning?

By examining the literature, particularly the current publications on the Internet, this paper explores current trends in distance learning to create a technologically aggressive vision for Marine distance learning.

b. Which government and industry organizations have successfully employed distance learning to augment/replace traditional training methods?

A survey focusing on Computer Based Training (CBT) by Kemske (1996) showed broad penetration of technology oriented distance learning into almost every area of US business, government, and education. There were 323 respondents from organizations with more than 10,000 employees. Examining a sample of different organizations to identify successful techniques and lessons learned will help form a vision for the Marine Corps.

c. What are the best metrics to calculate savings (if any) organizations realize after implementing technology oriented distance learning?

After completing the analysis of his survey results, Kemske (1996) said: "If there is a sword hanging over the head of the CBT community, it is the need for CBT managers to be able to justify CBT in terms of return on investment." The military is facing ever increasing scrutiny in the budget process and if there is going to be a capital investment in distance learning of any kind there is going to have to be a favorable return on investment (ROI) predicted. This thesis discusses the tangible and intangible costs and

benefits of various distance learning technologies, and recommends a framework in which to compare them.

d. Which distance learning methods/technologies best match the future needs of the Marine Corps?

By examining the missions of Marine organizations tasked with providing distance learning as well as the goals articulated by the Commandant, this paper seeks a match between distance learning techniques and requirements. By selecting technologies that leverage flexibility and growth potential against the needs of the Marine Corps, a model system can be described that meets the needs of students and husbands resources.

D. METHODOLOGY

The methodology is a combination of literature research and case study to reveal the pervasiveness, effectiveness, and potential of distance learning. The literature reveals surprising trends and sources in who is using distance education and what results they have obtained. The World Wide Web was the most current source for information on various distance learning techniques. There are several large clearing houses for distance learning information on the Web, the most notable being the Sloan Center at the University of Illinois. Journal research was almost entirely limited to technical articles from the publications of the Institute of Electrical and Electronics Engineers (IEEE).

The author attended the 7th Annual International Distance Learning Conference (IDLCON) in Alexandria, VA, from 24 to 26 March, 1997 and participated in both commercial and government seminars. The most remarkable commercial lecture was conducted by Mr. Doug Becker of Sylvan Learning Systems, Inc., that led to a subsequent

interview with a staff member. The Internal Revenue Service and the Army National Guard gave insightful briefings on their organization's employment of Computer Based Training (CBT) and Video Teletraining (VTT) respectively.

Contacts made at IDLCON led to a site visit to the 82nd Training Support Squadron at Sheppard Air Force Base (AFB), Wichita Falls, TX, from 28 to 30 May 1997. At Shepard the author was briefed by the squadron's CBT development team on the technical and operational aspects of CBT. Course developers demonstrated the tools and techniques they used for the creation of animation and simulations in support of both CBT and VTT. A satellite VTT lecture was observed in-studio, and the author had the opportunity to informally interview members of the technical production staff, as well as three experienced lecturers. The unit's Instructional Systems Specialist also conducted a detailed demonstration of the training decision support software, Advisor 2.0, that is a candidate for Air Force wide standardization.

To learn more about distance learning decision making, the author familiarized himself with Advisor 2.0. Through a series of e-mail messages, the software's author, Dr. J. Bahlis, answered specific questions about the program, as well as general questions about training decision support. Through open ended question and answers Bahlis helped the author understand the logic of the decision making algorithms behind Advisor.

E. ORGANIZATION

Chapter I has introduced the research problem and provides an overview of the history and structure of the existing system. It also discusses the methodology used, and lists the research questions. Chapter II provides a review of the information produced in

a review of the literature. Chapter III is a discussion of the different technology solutions being applied to distance learning and the direction the industry is heading. Chapter IV provides a framework for comparing different distance learning technologies and measuring the relative benefits. Finally, Chapter V provides conclusions and recommendations for the future of Marine Corps distance learning.

F. THE MARINE CORPS INSTITUTE (MCI)

1. Background

MCI is the Marine Corps' sole agent of distance learning. Founded in 1920, MCI is physically located at the Washington Navy Yard and is under the command of the Marine Barracks, Eighth and I. MCI has subsumed the duties of the former Extension School that "paralleled the tactical instruction at the residence schools." The Extension School offered correspondence courses that equated to the resident Professional Military Education (PME) courses at the Marine Corps Development and Education Center (MCDEC) in Quantico, which is now the Marine Corps Combat Development Center (MCCDC). MCCDC has organized all of its resident schools under the Marine Corps University (MCU). The Staff Noncommissioned Officer (SNCO) Academy, The Basic School (TBS), Amphibious Warfare School (AWS), Advanced Communications Officer Course, and Command and Staff College (C&SC) are all under the directorship of MCU . MCU collaborates with MCI in developing the non-resident PME courses.

2. Mission

MCI's mission is:

To develop, publish, distribute, and administer distance training and education materials to enhance, support, or develop required skills and knowledge of Marines and to satisfy other training and education requirements as identified by the Commanding General, MCCDC. (MCI, 1996)

Its tasks include:

- To provide nonresident occupational specialty training courses and professional military education.
- To develop and provide Marine battle skills training and tests.
- To develop and provide materials to support the individual training standards system.
- To support the ceremonial mission of Marine Barracks, Washington, D.C.

3. Structure

MCI's structure reflects both traditional military institutions and common business practices. MCI has six branches as shown in the Figure 1-1 below.

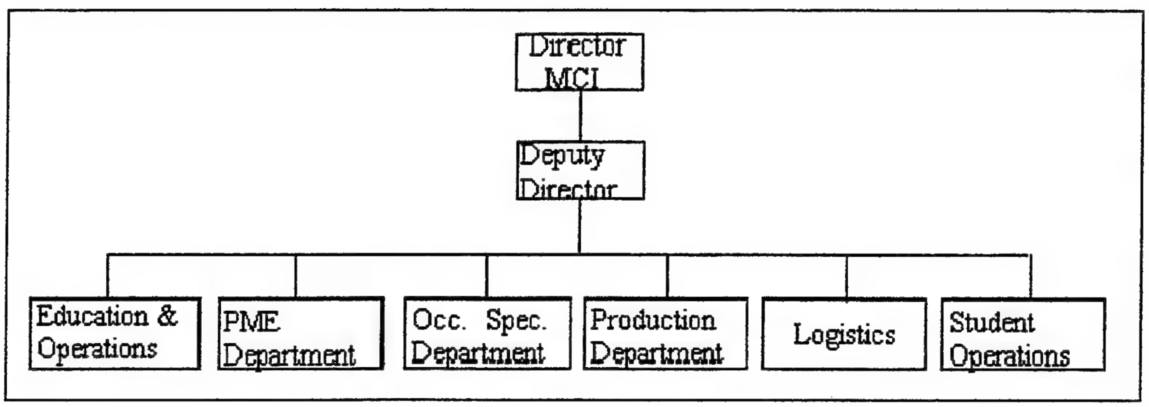

Figure 1-1. Marine Corps Institute structure.

a. Education & Operations

The "management" branch of MCI is responsible for annual fiscal and training plans for military and civilian personnel.

b. Professional Military Education Department (PMED)

PMED is tasked "...to provide distance education which is a prerequisite for or parallels the resident school curricula." (MCIAS Brief, Feb. 1996) To accomplish this, PMED develops and implements three enlisted and three officer PME courses in conjunction with the Marine Corps University:

- The Noncommissioned Officer Basic Nonresident program is the most popular course offered with 39,000 annual enrollments. This course must be completed before a Marine is promoted to the rank of Corporal (E-4).
- The Staff Noncommissioned Officer Career Nonresident program has 12,000 annual enrollments and must be completed in person or residence before a Marine is promoted to Staff Sergeant (E-6).
- The Staff Noncommissioned Officer Advanced Nonresident program is a promotion requirement for Gunnery Sergeants (E-7) seeking promotion. It has 8,500 annual enrollments.
- The Warfighting Skills Nonresident program has 11,000 annual enrollments and must be completed before a Marine may apply to Amphibious Warfare School. Additionally, 1st Lieutenants will not be selected for Captain (O-3) if Warfighting is not completed.
- The Amphibious Warfare School Nonresident program has 2,100 annual enrollments and is a prerequisite for promotion to Major (O-4).
- The Command and Staff College Nonresident program is a prerequisite for Majors seeking promotion. It has 1,500 annual enrollments.

c. Occupational Specialty Department (OSD)

OSD develops and maintains nonresident courseware for 156 non-PME courses. The courses are based on Individual Training Standards (ITS) generated externally by the appropriate Occupational Field (OccField) sponsors. Covering broadly diverse fields, many courses are always in revision. OSD also produces Battle Skills Training guides (pocket sized field manuals with basic "soldierly" tasks in them), and Job Aids like map scales and compasses that are not for specific MCI course but used widely in the fleet.

d. Production Department

This group provides technical editing, graphics layout, and printing and reproduction support. Most large run printing is done by the Defense Printing Office. The Production Department is a small but technically complete office that is capable of high quality camera and print ready artwork.

e. Logistics

This department procures, stocks, packages and distributes courses and training products. Logistics operates a new warehouse and a mail operation center and moves 2.2 million pieces of mail a year at a cost of $700,000.

f. Student Operations

This department supports the enrollment, grading and management of USMC distance education and training programs and also provides Information System (IS) support to the Marine Barracks. Monthly tasks include:

- Enroll students in 50,000 courses and subcourses per month.

- Grade 80,000 lessons and exams.
- Print and mail 100,000 tracking/status documents.
- Generate 45 reports for use internally by other departments, higher headquarters, and supported units.

4. Operations

MCI operations are focused in two areas: course creation, and course execution. In the first phase, creating a new course or rewriting an existing one, is an iterative process that takes a great deal of time. The process can be described as:

Identifying Need =>Writing =>Mass-Produce =>Stock =>Advertise

The need for a course can be identified by one of many sources. For OSD courses, the creation of a new MOS, the fielding of a new piece of equipment, or radical changes in tactics can trigger a call for a new course. Since they are by definition "institutional", PME courses are more frequently rewritten than created; PME courses are subject more to changes in doctrine and tactics than equipment. When the need for a course has been identified, it is carefully analyzed to extract specific requirements. Requirements, like learning objectives, level of mastery, and rank and skill level of the students are carefully delineated and passed to the course writers.

Course writing is the most time consuming phase of the process with resident teams from various military disciplines applying their expertise to the requirements. OSD courses are typically single-subject, one lesson courses. Courses in the current catalog range from a projected study time of 1 and ½ to 300 hours. PME courses typically consist of several sub-courses that are similar in size and conducted identically to the

individual OSD courses. For example, the Noncommissioned Officer Nonresident Course consists of seven subcourses: Marine Corps Drill and Ceremonies, Land Navigation, etc. When the OSD/PMED branches have designed the course and completed the technical editing, it is passed to the Production branch for literary editing, text and graphic layout, and initial reproduction. An iterative cycle begins between Production and OSD/PMED until the final layout and content of the course is satisfactory. The final element of this phase is mass production. MCI has limited ability to print courses locally, but almost all of the course are reproduced by the Defense Printing Service (DPS). DPS prints a trial run that is proofed by MCI, and after that is reviewed, a full initial production run is completed. Subsequently, courses are received at MCI and stocked in a warehouse. Once all elements for the course are on hand the course is opened for registration.

Finally, courses are advertised in several ways. Marines may learn about the new courses through fliers mailed to unit training officers. New courses are often featured in articles in journals, magazines, and the Navy Times and Marine Times. For PME courses, unit career counselors are notified of course requirements and who must take the course. Announcements are usually made before the course opening date and by the time most courses open, the fleet is well aware of the new course scope and prerequisites.

The second phase, course execution, has recently been addressed by an all Marine message, ALMAR 102/97, that indicates that the processes at MCI have been streamlined. Despite speeding up the process through the application of technology, the cycle from application to completion remains largely the same:

Application =>Registration =>Issue of Supplies =>Execution/Testing

=>Grading=>Crediting

Potential students may apply for courses in five different ways. MCI has interpreted the Commandant of the Marine Corps' (CMC) guidance, vis-a-vis level of service they are expected to provide, to require that even the most geographically or technologically disadvantaged student can sign up for a course. Consequently, MCI supports a diverse selection of ways to apply for a course. Students may fill out a postal card, or R-1 card, with their personal information and requisite course data and pass it to their unit training clerk who mails it to MCI after ensuring the data is complete, and that the Marine is eligible for the course. R-1's are manually entered into the Marine Corps Automated Information System (MCIAS). Within the last 3 years, all major commands have gained the additional ability to register students electronically via Unit Diary (UD) entry. Potential students fill out R-1's, which are checked by training clerks and passed to unit administration centers for entry on to the UD. Marines, particularly those at sea, can be registered by Naval Message. Finally, and when all else fails, MCI clerks will register a student via phone at the "800" number. The Executive Officer of MCI summed up their dedication to diversity when he said: "If there's a Marine out there with only a carrier pigeon, we would register him that way."

Once students are registered, MCIAS generates a shipping label that causes the material for in stock courses to be hand picked, shrink wrapped, and mailed to the Marine via 3rd Class bulk rate mail. Packages contain a text/work book and frequently come with relevant job aids (e.g. maps, compasses, firing charts, etc.). Until 1996, students were required to return individual lessons in a course to MCI for grading. When

the last lesson in a course was completed, a final exam was issued. Now, the students self test and the initial course mailing contains a sealed final exam that is supposed to retained by the training clerk until the lessons are completed. At that time the student is required to take a timed, proctored exam, and the proctor is responsible for mailing the test back to MCI for grading. PME programs are complete when all of the subcourses are completed.

Proctors mail completed final exams to MCI where they are opened by hand and fed through a scanner that grades all legible exams. The scanner builds a list of Marines who have successfully completed exams, and posts the results to the Marine Corps Total Force System (MCTFS). On average illegible exams and failures are rejected and graded by hand every day. Passes and failures from this process are entered by hand into the scoring system and the results posted to MCTFS. Completion certificates are printed in batches and mailed to students.

5. Significance of MCI

The significance of the MCI to Marines and the Marine Corps cannot be overstated. Annually, MCI delivers distance learning to 140,000 students worldwide, many of whom would unavailable for other methods of instruction. At a distance, MCI provides two crucial services, training and education, that the Marine Corps could not afford to provide on a resident basis.

The MCI course catalog contains over 150 OSD titles ranging from the necessary "Counterterrorism for the Fleet Marine," to the common sense "Financial Management," to the practical "Refrigerator Repair." The Marine Corps can efficiently assure a baseline

knowledge in the fleet by directing all Marines to complete a given course. For example, when the Marine Corps pay system changed from hard checks to direct deposit, the financial management course was prescribed as a remedy to the flurry of bounced checks. In the wake of the rise of international terrorism, particularly the bombing of the Marine Barracks in Beirut, a thorough individual counterterrorism course was designed and prescribed for the fleet.

MCI also supports one of the cornerstones of Marine Corps promotion philosophy: a belief in the intrinsic value of continuous, progressive professional military education. The first stepping stone for an enlisted Marine towards a career is the Marine Noncommissioned Officer Nonresident Course. Every opportunity for promotion through 1st Sergeant/Master Sergeant comes with a new requirement for PME. The officer course progression parallels the enlisted with required PME starting with Warfighting for Lieutenants and ending with Command and Staff for Majors. The fact that a Marine fulfills PME requirements through the nonresident programs offered through MCI is irrelevant, and viewed without prejudice by promotion boards. In September of 1996 CMC unequivocally restated the fact that "as of 1 Jan 96, successful completion of the appropriate level nonresident PME course is required for promotion." (ALMAR 339/96). Despite the finality of his statement CMC was soon required to waive his regulation because "Enforcing the new PME requirements this year would have meant that the severe shortages in reserve component SNCO's would significantly worsen." (ALMAR 458/96)

6. Problems of MCI

Problems with MCI fall into several categories. First there are those that individual Marines perceive as poor service issues or shortfalls in the performance of MCI. Those are represented in Figure 1-2 below:

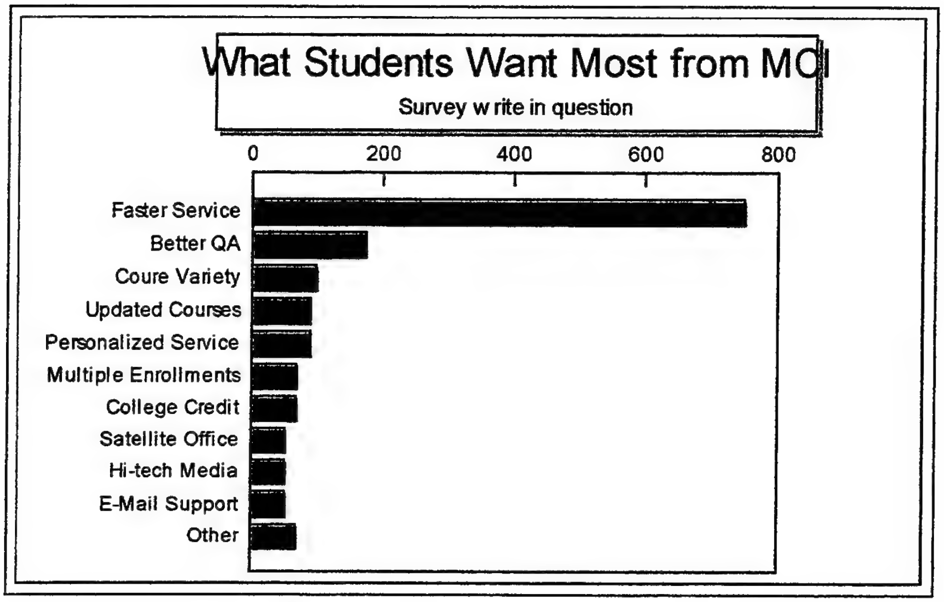

Figure 1-2. Source: MCIAS Brief (Feb 1996)

The most frequent complaint has been a requirement for faster service. These issues were addressed in ALMAR 051/96 and corrective actions were taken. On the 31st of March 1997 CMC reported out on the completion of service fixes at MCI. The changes were not revolutionary, and focused largely on connectivity and software issues internal to MCI, and with speeding up backorder print jobs from the Defense Printing Service. (ALMAR 102/97) This "answered the mail" on the largest number of complaints, but the rest of the complaints will largely be ignored in this recent fix.

Other problems with MCI are structural and cultural issues that are not going to be fixed by merely retrofitting the current system or speeding up the existing processes.

Two key issues that need to be addressed that are core to the institution are: 1) the discontinuity in the development and execution of the non-resident PME courses, and 2) the course structure and delivery method.

a. Discontinuity in Development and Execution

The disassociation between the Marine Corps University and MCI needs to be addressed. MCU's mission statement declares that it "...develops and implements policy on PME for the Marine Corps. We foster continual professional development of all Marines." Unfortunately, MCU which "develops and implements" PME and MCI which executes it are in two separate chains of command, in two different states, with wildly diverging "real" missions. While MCU's mission is purely focused on education and the development of doctrine, the true bottom line at MCI is that, from May to September, almost every Marine that works at MCI marches in two of the District's premier military parades, the Tuesday evening sunset parade at the Iwo Jima Memorial in Arlington, and the Friday evening color ceremony at Marine Headquarters, Eighth and I. Period!

This lack of continuity in the process was recently highlighted during a recent Joint PME accreditation examination when MCU won the highest praise for its resident education program, and criticism in its correspondence component. (Phillips, 1997) Packing up all of MCI and moving it to Quantico under the Marine Corps University would satisfy both military and business sensibilities, but the political sensitivity of the parade issue is daunting.

b. Course Structure and Delivery Method

While the overwhelming demand by students for timeliness in delivery, completion, and grading of courses has been met by automating many of its processes (registration, grading, etc.), MCI has not significantly diverged from the 200-year-old, traditional correspondence school model of distance learning. With the exception of a pending Counterterrorism program, MCI has not radically changed its delivery method since the 1920s. The process automation recently completed at MCI should improve customer satisfaction, but does not address two basic business issues for an educational institution: delivering more/better distance learning, and maximizing the utility of funds available to do so. There are three areas that current and evolving distance learning technologies hold the most promise for improvement:

(1) Course Writing and Revision. The process used to create current MCI courses is like the traditional waterfall technology development cycle being replaced throughout Department of Defense (DoD), which was acceptable in an era when an acceptable timeline for production was measured in years.

(2) Printing/Storage/Issue. To fulfill promises of quicker service, MCI has sped up a process that is rapidly becoming outdated. The process of printing and storing course material will become increasingly cost prohibitive and appear increasingly anachronistic in an age of electronic media.

(3) Execution/Testing. Again, the 1996 improvements at MCI did not address the areas that may hold the greatest opportunity for improvement: the opportunity to present better courses at less cost.

G. SUMMARY

MCI is an integral part of the Marine Corps' training and education efforts. The Institute is managing an increasingly important burden that with an anachronistic business process as well as can be expected. The following chapters will provide more information on distance learning, and a look at the a potential future for the Marine Corps distance learning effort.

II. LITERATURE REVIEW

A. TRADITIONAL DISTANCE LEARNING

Official record book entries about command, billets, combat, decorations, time in the fleet, time in the supporting establishment, are all shades of gray that compose a picture of a Marine for the promotion board; as long as all of these requirements are in some degree of balance, a Marine surely is "promotable." Professional Military Education (PME) is one of the few black and white requirements for promotion. Because it is unfinished, Command and Staff College has significant importance to the author. The onerous and daunting nature of a 50-pound correspondence course has given him reason to ask : Is this the only way?

Without considering St. Paul's Letters to the Corinthians, Mood (1995) suggests that distance learning has its roots in the establishment of regular mail service. The literature applies many names to this learning system: Asynchronous Learning (ASL), Distance Education, Mediated Learning, On-line Education, computer-based training (CBT), etc., all of which describe different permutations of a system of education that departs from the traditional classroom-based learning model. Mood (1995) synthesized Desmond Keegan's (1986) definition of the characteristics of distance learning, they are paraphrased here:

- Teacher and Learner must be separated for most of the process.
- The course must be controlled by an organized educational institution.

- Some form of media must be used to overcome the separation of time and space.
- There must be a feedback loop.

As early as 1728, a gentleman in Boston offered a series of shorthand courses via correspondence that were archetypal. (Mood, 1995) Students submitted their courses by mail for evaluation and critique, and then completed an examination for certification. The problems that plagued distance learning then were: time delay, misunderstanding between teacher and student, unreliable postal service, and the perception that distance learning is "second best." These same problems afflict the Marine Corps distance learning system today.

B. ALTERNATIVE DISTANT LEARNING TECHNIQUES AND MEDIA

While the Marine Corps has soldiered on with correspondence courses, the distance learning industry has evolved in step with new technology. For the past 70 years, distance learning has migrated to successive forms of electronic media. This section examines the background of those efforts and techniques are currently being employed.

1. Correspondence

As mentioned in the introduction, the inception of distance learning is tied directly the establishment of reliable mail service. Mood (1995) illustrates the growth of traditional correspondence courses in the UK and US starting as early as 1728. Through the 19th century, correspondence programs flourished and embraced more diverse topics, from accountancy to mine safety. As time progressed, so did course complexity. In the early 1900s the Chautaqua Institute and other intellectual collectives offered

correspondence courses in addition to their traveling lecture programs. Today, traditional correspondence schools still flourish, with hundreds of public school districts, colleges, and private organizations offering a huge selection of courses from certificate courses in Bible study and basic Arabic, to postgraduate degrees.

2. Audio

When commercial radio exploded worldwide in the 1920s, it wasn't long before the medium was used to deliver distance learning. Despite a complete lack of interactivity with target audiences, the penetration and impact of the BBC, Voice of America, and Radio Moscow in the 3rd world is undeniable. More than 70 years after its inception, radio-based distance learning is still pervasive in areas with the most financially and technologically disadvantaged users. Cheap and reliable, radio is an effective medium for delivering some topics, particularly languages. An outgrowth of radio was the profusion of recorded media, first in the form of records, than magnetic tape cassettes. Foreign languages were and are still the most likely candidate for this media, however, there is a booming industry in the marketing of many self-help and personal growth programs on tape.

3. Video

In the 1940s film production became affordable and accessible enough to be feasible for classroom use. Through the early 1980s when film began to be replaced by video, films and filmstrips were the most pervasive forms of distance education used in US schools. Suffering the same lack of interactivity as audio technologies, video nevertheless qualifies as distance learning because it fulfills the separation of time and

space between the teacher, who in this case is the film's producer, and the students. However the expense of producing films made this medium an impractical substitute for classroom teachers, and the use of film was relegated to the delivery of select topics.

The expense of film production and projection equipment kept film from penetrating to disadvantaged students, i.e. students in rural or small school districts, or those in studying less common subjects. The advent of video tape, first in the Betamax format, and finally in the ubiquitous VHS format has made this distance learning medium available to all but the most disadvantaged users in the 1990s. The key to this first big leap in video technology was the development and rapid societal penetration of the television. As early as the late 1950s, many experiments had been conducted, particularly at universities, to assess the effectiveness of television in teaching. Chu and Schramm did the benchmark studies of effectiveness in 1967 and 1975 (Wetzel, et al. 1996) and established what has been proven time and again that televised lectures were just as effective as those delivered in person. Despite the lack of interaction, susceptibility to boredom, and "talking head" delivery style, distant students' comprehension and retention was statistically similar to that of local students.

Television truly set the stage for the next revolution in distance learning. Among the most important aspects of television's development are its flexibility and accessibility. The ability of television to economically and instantly transmit voice and video made it an ideal medium for distance learning. The prohibitive expenses of producing, editing, storing, and distributing film were obviated by television, and put video training within the economic reach of many universities.

While television was a technological step forward for distance learning, until the early 1980's it still shared the limitations of other electronic media. Like radio, it was an instantaneous medium for most users. That is, it was beyond the capabilities of most students to capture, store and replay televised courses. And like previous forms of electronic distance learning, it lacked interaction between teacher and student. Despite the creativity, effectiveness, and success of organizations like the Children's Television Workshop, and the Corporation for Public Broadcasting, television has not become the preeminent medium for the delivery of distance learning.

III. CURRENT AND FUTURE TECHNOLOGIES

A. INTRODUCTION

Technological advances in distance learning have paralleled the development and propagation of postal service, radio, and finally television; as soon as these modes of communications became something other than experimental, someone began using them for distance learning. Since the late 1960s, an evolutionary movement in distance learning has paralleled the exponential growth in quality and speed of, and access to computers. Distance learning innovators have followed the computer industry stride for stride, successively providing courses on mainframes, stand alone PCs, client/server networks, and most recently the Internet. Technology has been leveraged to produce asynchronous distance learning, where students can complete courses at their own rate at the time of their choosing, and synchronous methods, where dispersed students gather electronically to learn. The diverse asynchronous methods used to deliver distance learning today are outgrowths of computer-based training (CBT) methods, while the more technologically demanding synchronous methods are more closely related to the broadcast radio and television courses of earlier years.

B. COMPUTER-BASED TRAINING (CBT)

1. Background

The modern distance learning model that most students are familiar with is Computer Based Training (CBT). Other terms frequently applied to this technique are

computer-aided instruction (CAI), interactive courseware (ICW), and recently internet-based training (IBT). Gery (1987) defines CBT as :

> An interactive learning experience between a learner and a computer in which the computer provides the majority of the stimulus, the learner must respond, and the computer analyzes the response and provides feedback to the learner.

Early CBT courses were developed for large corporations and government agencies. The courses were typically text-based and mainframe mounted courses that were effective at teaching many skills, but monotonous and uninspiring. Despite a lack of color, audio, video, and graphics, early CBT proponents enjoyed great success. A 1975 meta-analysis of 30 Department of Defense (DoD) studies by Orlansky and String for the Institute for Defense Analysis showed that computers were a highly effective way of delivering some types of training, and appeared to be cost beneficial.

Orlansky and String compared four types of instruction used to deliver entry level technical skill training: traditional platform lectures, individual instruction (similar to correspondence courses, but conducted in residence), computer-aided instruction, and computer-managed instruction (CMI), which is individual instruction with student performance assessed by computer. For the present paper, their most germane comparisons were among the first three: "Student achievement at school using CAI is about the same as that with conventional instruction...the differences in achievement are not thought to have practical significance." In other words, over time, studies have repeatedly indicated that CBT is as effective as both traditional classroom and correspondence education in delivering the types of instruction covered by their survey.

Twenty years ago, Orlansky and String had the problem experienced by many people today who are considering migrating to some form of computer-based distance learning: capturing costs. The difficult task of capturing costs associated with distance learning is addressed later in this thesis, however there is one easily captured metric of success that convinced the early researchers of the efficacy of CBT, and that is time. The 30 DoD CBT courses they studied, ranging from lathing to electronics, had a median time savings of 30 percent over traditional classroom instruction. Orlansky and String investigated the studies that did not approach the median time savings and attributed the deviants to poor course preparation or catastrophic equipment failure. This figure is in line with the 34 percent time savings calculated by Kulik (1994) and the median 28 percent Fletcher calculated in a1995 meta-analysis of 23 studies. A single statistic has withstood over twenty years of studies, "On this basis, reductions of about 30% in the time it takes students to reach a variety of instructional objectives seems to be a good bet." (Fletcher, 1996)

2. Characteristics of Modern CBT

As Gery (1987) has noted: "At the end... learners will have learned what they damn well please. And its our job to...create the motivation to learn." Interaction is a key tool used to successfully motivate distance learners. Fletcher (1996) compares the results of six experiments that all indicate that "increased interactivity increases student achievement." Correspondence courses are deficient with respect to interactivity because of the latency of mail and the obviously static nature of print media. However, in the past several years, authoring tools have been written that allow for the cost effective

creation of CBT courses that overcome the shortcoming of correspondence courses and previous generations of CBT by focusing on student interaction and multimedia content. The term CBT has increasingly been replaced with ICW because it is a more accurate description of the process.

The Navy Office of Training and Technology (NOTT) describes several ways that interactivity can be measured, including linearity and branching, feedback and remediation, and gaming and simulation. (NOTT ICW Internet site) Having a student watch a videotaped lecture or demonstration is an example of high linearity and no branching. The lecture runs straight through from introduction to conclusion with no opportunity for a student to ask questions or to pursue parallel or divergent paths of learning. Surprisingly, some studies have indicated that though students find this method boring, it is statistically as effective as sitting in a lecture hall if "effective" is defined as a measure of the percentage of students who can pass a test. Chu and Schramm (1967) discovered that adding a feedback loop, whether it is "an acknowledgment, confirmation, prompt or hint, reinforcement, explanation, or referral to another source" (Gery, 1987) significantly increases the student's attention level, cuts down on attrition, and increases mean test scores. It would be interesting to replicate Chu and Schramm's study today to determine if a cultural shift has taken place in which the MTV generation of students might be even less likely to soldier on in a boring linear class, but might respond favorably to one that is highly interactive.

A trend in modern CBT is to "flatten" the course. Flattening entails reducing linearity by removing the number of levels in the hierarchical structure and creating

courses where students are able to easily move laterally from module to module through a series of logically related links. Pioneered by programming tools like Hyperlinks found in Hyercard, and Hypertext Markup Language (HTML) techniques, which dominate the Internet, most modern CBT authoring tools create courses that allow students to "jump" to from one topic to another by selecting a (usually) highlighted keyword. The key to successfully implementing this capability is to ensure that students can easily return to where they were before they jumped, allow students to peruse the course on paths of interest to them, and ensure that they have mastery of all the course objectives. An interesting benefit of nonlinear structure is reduced course completion time beyond the expected 30 percent. Because the new courses do not rely on linear progress to make sense, comprehensive pre testing can be used to restrict the amount of information a student must read and respond to for completion. Students may move quickly to material that is interesting and new to them saving overall course completion time.

Gery (1987) states: "Feedback is the evaluative or corrective information about an action, choice, or inquiry that the learner has made within a program." Before the mailing process was streamlined in 1996, MCI required students to mail all of their section tests back to Washington for grading and evaluation. Students with incorrect answers were referred by mail to appropriate parts of their course material, and were not sent their final exams until they had demonstrated mastery of all of the course subsections. In an effort to reduce turn around time, this process was discontinued and now students self test at the end of sections. There is no analysis of the student's progress, or remediation of non-mastered material. CBT, however, offers the ability to administer module or section

post tests, assess a student's comprehension, and remediate that student in a focused manner. Analysis run on missed questions can quickly redirect a student through hyper links to the non-mastered segment. Students can retest when ready, and progress to the next module when they have demonstrated mastery.

Gaming and simulation are examples of the highest level of interaction in computer-based training. Allowing students to manipulate variables in experiments and immediately observe the results adds another dimension to the learning experience. Many PC- based simulation programs available as add-ons to commercially available spreadsheet and database programs can generate real time, animated or graphical representations of problems that are difficult to describe economically. Completely describing all the phases of an amphibious landing could arguably take dozens of pages of text and diagrams, while a simulation (combined with animation) of an amphibious landing can be speeded up and played out in minutes. Adding a gaming dimension also allows the student to "what if?" some scenarios. For example, if a student of amphibious warfare was studying the subject of hydrography (critical to selecting landing beaches), the student could be offered the opportunity to pick a "bad beach." A bad beach might proscribe the use of landing craft and limit the landing force to using just amtracs and air cushioned landing craft (LCAC) to get ashore. By running the landing scenario under new conditions, the student could compare the times required to build up combat power ashore and see the impact of a bad decision.

Table 3-1 below, created by the Navy's Office of Technology Training (NOTT), displays a useful taxonomy of current CBT capabilities divided into three categories, as

described in the Military Handbook (MIL-HDBK) 284 Part 3.

	Category 1(A&B)	Category 2	Category 3
Capabilities			
Interactivity	Low	Medium	Extensive
Sequence Control	Low	Medium	Extensive
Simulation	None	Simple Processes	Complex, Real Time
Branching	Low	Medium	Extensive
Remediation	None	Low	Extensive
Feedback	Low	Medium	Extensive
Management System	None	Medium	Extensive
Gaming	None	None	On request
Video	Yes	Multimedia capability	Multimedia Capability
Text	Yes	Yes	Yes
Graphics	Yes	Yes	Yes
Audio	Yes	Yes	Yes

Table 3-1. CBT Capabilities. Naval Office of Training Technology.

- Category 1: Baseline Presentation. This is the category with the least interactive courseware, which is best suited for knowledge or familiarization lessons, in linear format that usually focuses on a single idea or concept.
- Category 1A: Video Presentation with a small amount of text.
- Category 1B: Graphics presentation with a small amount of text.
- Category 2: Medium Simulation Presentation. This includes lessons where students must recall more information than in baseline presentations, and the student has more control over the lesson presentation (linearity).

- Category 3: High Level Simulation Presentation. This refers to instruction on complex or abstract subjects, with a high level of interaction, extensive branching, and which may be capable of real-time event simulation.

3. CBT Delivery Methods

Up to this point, CBT has been discussed in terms of structure and content, but not in physical terms. CBT developers have capitalized on the increased computer capacity and connectivity over the past 30 years and moved CBT from the mainframe to many different platforms, specifically compact disc (CD), networks, and the Internet. Kemske's (1996) report indicates that mainframe computer use as a delivery means has dropped from 17 percent to 15 percent in two years, and subjects of his survey indicate that they are migrating to "micro platforms." Kemske projects that mainframe use will be down to 10 percent in 2 years. Comparatively, his subjects reported a growth in CD and local area networks (LAN) based CBT delivery at their organizations of 37 percent and 41 percent, respectively, between 1995 and 1996. Additionally, respondents projected similar increases in the next year. Finally, 60 percent of Kemske's respondents indicated that they intend to begin delivering distance learning via the internet (or some other internet protocol (TCP/IP) connected technology) in the next year. In this section CD, LAN, and internet technologies are discussed for delivering distance learning.

Compact discs were the first inexpensive mass-storage device available for individual computer users. Offering a storage potential of over 600 megabytes of data and transfer at rates necessary for quality multimedia presentations, the ubiquity of these devices make it an ideal medium to distribute CBT. Storage capacity on a CD is not

unlimited, however. While ideal for delivering text, graphics, sound, and animation, 600 megabytes is not "a lot" of storage space when full-motion video is concerned.

A recent development that has the potential to quickly eclipse the CD is the Digital Video Disc (DVD), sometimes called the Digital Versatile Disc. The DVD can be described as the progeny of the CD (it has the same 5-inch diameter) and the Laser Disc (movie length storage capacity). The most advanced DVD carries data on both sides, and in two layers per side with a total capacity of 15.9 gigabytes of information. (Salzman, 1997) For scale, consider that discs currently available easily hold an entire movie per side at a resolution three times finer than a top end VHS system. Most DVD players are backward compatible and will read CDs. DVDs offer a technologically feasible alternative for applications that require the use of memory consuming video. As Demme says, "The increased capacity and extra data transfer rates mean that many technical barriers (colour palette, quarter/half screen 15 fps, etc.) confronting multimedia developers producing CD-ROM content will disappear with DVD." (AME, 1996)

When an organization's requirements move beyond single course/single student,. networked solutions to CBT are a logical choice. Local Area Networks (LAN) and the Internet are two very popular methods of distributing CBT whether the students are gathered in a dedicated CBT classroom, or working alone. Use of either is not mutually exclusive, and many LANs offer subscribers Internet access. Before discussing the details of networked CBT, there are three issues to consider when evaluating a network: availability, throughput, and latency.

Availability is the percentage of time that a particular function or application is available to users (Stallings, Van Slyke 1994). For a Marine system, this is a key consideration because it will be subject to off-duty hour peaks. Any distance learning network needs to be capable of handling bandwidth consuming multimedia courseware at peak periods.

Throughput, measured in megabits per second (Mbps) , is the speed at which information can be delivered to end users. Throughput is a function of the physical constraints of a network, and actual throughput considers physical constraints plus losses due to operating system overhead, etc. and gains realized through coding efficiency and compression.

Latency is a potential problem in many computer networks. Since networks are by definition, designed to be shared, information sent across it is "is broken down into smaller components, called packets, and the address of the destination is appended to each packet. The advantage of packets is that since their destination is included, they can travel over a variety of paths in the network and packets from many messages can share a single circuit, thus optimizing the time and distance it takes to make their journey." (Maitland, 1996) Since many networks are designed to deliver packets by the fastest route possible, in a stream of packets some will use different routes and arrive out of sequence. When delivering e-mail, this is not a problem because the transaction is not complete until all of the packets arrive and are put in the proper order, however, latency can hinder the effectiveness of more complex multimedia CBT courses.

Without broaching the ever-growing body of information about LAN technology and topology, it is essential to say that LANs are usually a group, or groups of computers linked electronically that share storage and peripheral devices with one another for reasons of economy, speed, consistency, and convenience. As a tool for distance learning, LANs are the closest analogy to the original mainframe-based distance learning tools of the 1960s and 1970s. Modern LANs offer tremendous advantages in their ability to deliver the same robust multimedia training available on compact discs but with out the drawbacks of physically distributing the media. By retaining the course material on a network (or Internet) server, the course administrator has absolute control over content and consistency. There are no "old versions" of courses floating around, a problem that requires MCI to maintain the capability to administer courses that are out of date, obsolete, or worse yet, canceled.

Until the last several years, networks were limited by the speed of the servers and throughput of network devices such as switches, routers, and the physical transmission media (coaxial cable, twisted pair, etc.). The throughput issue is becoming less unimportant as LAN speeds increase. Throughput of 100 mbps with 100baseT systems is more than adequate for delivering multimedia, but fiber optic networks capable of several hundred mbps, and the recent announcement of several corporations of their gigabit ethernet devices ensures that network-based distance learning is a viable consideration. (Birinato, 1997)

The roots of the Internet have been described in many places but for the current study it is important to say that the protocols defined by the Defense Advanced Research

Project Agency (DARPA) and the subsequent DARPA net have grown beyond its founders' wildest imagination. What started out as a way for a handful of research centers to share data with their DoD counterparts, has exploded into a major cultural force with users counted in the millions. The logic of the World Wide Web, the front end to the Internet most users see, is firmly rooted in the idea of hyper linking and multimedia. Consequently, many universities and other educational organizations are offering high-quality interactive CBT via the Internet, some with a very high level of multimedia content.

Viewed as an outgrowth of networked CBT, internet-based training's (IBT) advantage lies in the (near) universal accessibility provided by the Internet Protocol (IP). The Internet provides access, albeit at a far slower transfer rate, to networked courses that are independent of location or platform. The same course can be delivered to a student sitting at home with a Macintosh or a PC, or to a group of students sitting at workstations in a lab.

An exciting example of Internet Based Training is a program called Interquest at Oregon State University. Under the Interquest project, a multi-discipline group of professors and researchers combined skills to create not only the tools to create, maintain, and administer IBT, but have designed and implemented courses themselves that have enjoyed great success. The first course offered, and one that has enjoyed broad success, is a course created and taught by Dr. Jon Dorbolo. (Dorbolo, 1997)

Dorbolo's course, <u>Introduction to Philosophy</u> has completed eight course cycles, with an average class size of 50. The course can be described as semi-synchronous;

students have 24 hour access to the course, however they are expected to complete a series of course work submissions over a 10-week course cycle. The course is completely Web-based; there are no books, or paper submissions because all readings, lectures, quizzes, group projects and tests are done over the Internet. View from the perspective of the NOTT taxonomy, the course is moderately interactive. Within the modules that comprise the course linearity is low and there are many opportunities to branch. Feedback and remediation is mediated by the course administrators. Currently, the course employs text and graphics, but no multimedia content. Dorbolo reports that after matriculating 1000 students, failures and withdrawals are "Not more than in classroom taught courses."

Dorbolo makes extensive use of surveys, discussion groups, and course evaluations to iteratively refine the course through a "set goal-try technique-evaluate technique-revise technique." The course has been very popular with high school and continuing education students in Oregon because the credits are wholly transferable, satisfies core curriculum requirements at Oregon State, and is offered at a considerable discount over the resident courses. Currently, the Interquest management system is being revised to conduct an experiment to test its ability to simultaneously handle 300 students in a single course, and then a 1000-member class.

The depth and complexity of a philosophy course is relatively analogous to a PME course. If the Interquest system proves capable of handling a large number of students simultaneously, it could serve as a suitable model for an MCI internet-based solution for distance learning.

Occasionally, technological leaps happen that take almost everyone by surprise. The Chief Executive Officer of Silicon Graphics Corporation didn't know what an Intranet was until his firm converted their corporate network to it almost overnight. (McCracken, 1996) Intranets are local Internet systems, where users access different programs, documents, and files via a Web browser instead of traditional network software. Intranets leverage the accessibility advantages of IP with the high transfer rates of LANs. As many firms move from LANs to Intranets because of the economy and flexibility of the architecture, Inter/Intranet distance learning will grow proportionately.

4. CBT Summary

Computer-based training has been a cornerstone of the distance learning business for over 30 years and will flourish as PC and connectivity capabilities increase while costs drop. It has been effectively employed to transfer both skills and knowledge with the only drawbacks being in the costs of production and delivery, which have been obviated by recent developments in CBT authoring tools and delivery methods. Many courses, traditionally taught in residence, have been successfully converted to CBT. Though a robust and effective delivery method, CBT will certainly continue to evolve as it traditionally has, apace of technology.

C. VIDEO TELETRAINING (VTT)

1. Background

In the past, one of the greatest challenges MCI has faced is translating the spontaneity, flexibility, and interaction enjoyed by students at resident PME courses to a static medium. As previously proposed, CBT is the appropriate answer for some cases.

However, more abstract or complex subjects may need a more dynamic medium, which can be found in two-way audio and video. Since the subject of using film and television to deliver distance learning has been previously discussed, this section focuses on recent efforts to use computers and computer networks to deliver video teletraining (VTT).

2. Characteristics

Video teletraining delivers distance learning in a format closely related to the classroom paradigm familiar to most students. Though it has only recently begun to challenge CBT's early dominance in the distance learning market, VTT predates CBT the way television predates the computer. VTT has two major characteristics that can be used as a framework to describe the whole body of study, synchronicity and interactivity. These terms respectively describe at what point in time the teacher teaches and the students learn, and the degree to which they interact. Though closely related, the subjects will be treated separately.

The defining moment in VTT evolution may have come at the unremarked moment when PC and network technology developed to the point where it was economically feasible to purchase both equipment and bandwidth necessary to effectively deliver distance learning. Before this point, most VTT was asynchronous; that is, teachers and students were separated by time (and perhaps location). Films and filmstrips, television broadcasts, and videotapes were the early asynchronous models. Current asynchronous methods are most similar to the latter two. The recent development of high speed/high capacity video servers has allowed students (either individually or as a class) to use networked computers to view previously prepared lectures, but the most

exciting area of growth lies in the techniques and technologies used to provide synchronous distance learning. Advances in networking and computer speeds, signal compression technology, and connectivity (satellite, Internet, etc.) have made it economically feasible to conduct real-time lectures at a distance. Additionally, it is increasingly feasible for students to be reciprocally connected to the teacher. Cheap, fast, networked computers make this type of connectivity possible, and open a wide range of schemes that are best described by their degree of interaction between teacher and student.

Unlike CBT, where interaction (linearity and branching, feedback and remediation, gaming and simulation) are programmed into a course in advance, interactivity in VTT is mediated by a real teacher. The utility of VTT, therefore, is largely a factor of the technology available to deliver it. Technology places the teacher in control of the direction and pace of the class, with the ability to capitalize on interplay with and between students to enhance learning. Using Crawford and Suchan's (1996) modified "richness" continuum (Daft, Lengel and Trevino, 1987) the breadth of VTT interactivity can be described as shown in Table 3-2:

Instructor	Video	Audio	Classroom	Richness
Video tape	One way	One way	Local	Lean
Local	One way	One way	Remote	Lean
Local	One way	Two way	Remote	Moderate
Local	Two way	Two way	Remote	Rich
Local	Two way	Two way	Local and remote	Rich

Table 3-2. Interactivity Richness. Source Crawford and Suchan Understanding Video Teleducation: An Overview.

The richer the environment, the more interactivity the course can offer. Clearly, at each level along the richness continuum the discriminator is the amount of feedback the students have available. The leanest environments offer no feedback at all, while the moderate range encompasses those archetypes in which the students can interact with the teacher via e-mail or audio. The richest environments are those where the teacher and students form a virtual classroom where the teachers can see all of the students, and the students can see the teacher and perhaps some or all of the other students.

In many studies, VTT has proven to be as effective as being in class with a teacher. As video technology has advanced from the early days of "talking heads" the efficacy of video delivery has been reinforced through experimentation. In 1995 a study was done on a Navy Quality Assurance Course delivered in the traditional lecture method and a rich VTT environment (two way audio/video). The results, depicted in Table 3-3, clearly indicate that there is no significant difference between results attained with either method.

Group	Number of Students	Number Failing	Number Passing	Percent Passing
VTT Local	48	0	48	100
VTT Remote	52	0	51	98.1
Traditional	133	5	128	96.2
Combined Groups	233	5	227	97.4

Table 3-3. Percentage of Students Passing Course: Source: Wetzel, Pugh, Van Matre, Parchman, Video Teletraining of A Quality Assurance Course with a Computer Laboratory. *Chi Square of 2=2.09, p>.05 there is no significant difference between groups.

VTT has proven its ability not only to deliver "lecture" style classes, but courses that involve both multimedia and simulation. The Air Force has been broadcasting VTT from Sheppard Air Force Base in Wichita Falls, Texas since 1996. The 82nd Training Support Squadron produces and conducts courses that had previously been conducted in residence. Using a system of one-way video and two-way audio to create a "moderately" rich in environment, the 82nd TRSS uses lectures, slides, video and animation to effectively deliver courses on a variety of complex jet engine maintenance subjects. Anecdotally, the VTT instructors universally agreed that their "comfort level" would be significantly raised if they enjoyed a reciprocal video connection of <u>any quality</u> with their students to capture critical nonverbal feedback.

3. VTT Delivery Methods

Synchronous VTT is by far the most complex of the two procedures. The literature reveals no single best delivery system, so several representative schemes are discussed here. The most simple way to examine the issue is to divide it into classroom systems and delivery systems.

Whether it is a professional broadcast studio, a dedicated classroom setup for VTT, or simply a desk with a camera and microphone on it, the teaching end of the VTT system is commonly referred to as the "local" classroom. The student end is the "remote" classroom. Because it is the most equipment intensive, the local VTT classroom is predictably the most expensive component, however, exponential increases in technology available for distance learning have decreased costs.

There are up to three cameras involved in a typical VTT classroom. The teacher's camera is the most important piece of equipment in the local classroom. This device must be able to hold its resolution as the teacher moves, writes on the board, and answers questions. Distance learning lecturers frequently complain that they feel "tied to the podium" by inflexible equipment. This complaint is often magnified when teachers simultaneously lecture to a local and a remote class. The second camera serves as the VTT corollary of the overhead projector. This camera, sometimes referred to as a "Crane" camera allows the teacher to place sketches, drawings, and overheads on a platen and have the images transmitted to the students. If there are students in the local classroom, the third camera is usually at the front of the class focused on them. This allows remote students to see their peers during questions or discussions.

An electronic whiteboard replacing the traditional chalkboard for notes and sketches. The whiteboard concept has evolved quickly in the last few years and is an indispensable tool in the local classroom. Readily available and surprisingly affordable, large-scale whiteboards (up to 2 meters measured diagonally) have been designed specifically for the VTT classroom. They are large enough for the teacher to use them to present slides (like Powerpoint) for the local classroom, while the touch-sensitive screens allow the teacher to draw or write on it. In the synchronous environment, remote students may share this space with the local classroom by using a mouse or tablet to draw or write on it. Most systems allow the whiteboard images to be saved or printed to capture ideas or concepts. In studio style local classrooms, advanced "Blue Screen" techniques can be used to simultaneously transmit the image of the teacher, and prepared slides or images.

Though classroom audio systems are mediated in software, the local microphones, like the teacher's camera, must be very flexible. As speakers move about the room, turn their heads to answer questions, or different speakers speak, the microphones must be sensitive enough to hear a range of speakers.

At a minimum, the local classroom must have at least one monitor so that lecturers can see themselves and their prepared material. Another monitor is required for the local students to see prepared materials if a large whiteboard isn't available. In the richest interactive environments, both teacher and local students will have at least one monitor to see the remote students and any materials they want to present. The three experienced military VTT lecturers interviewed repeatedly emphasized the desirability of having the ability to see the remote students to capture critical nonverbal communications.

Clearly, the local VTT classroom can be a complex and even intimidating environment. Though simple systems can be run by the teacher, it is not unreasonable to assume that additional personnel may be required to technically produce a class. The most interactive classes may require a studio crew to handle all of the technical aspects of production leaving the teacher free to concentrate on teaching.

Remote VTT classroom set up is considerably more flexible than local classrooms. In the leanest environments nothing more than an appropriately connected TV set is required. In moderately interactive environments, single students or classes with some kind of connectivity (network, Internet) can be economically equipped with a PC and inexpensive accessories. Currently, even entry-level computers are powerful

enough to handle single student needs; sound boards are standard in most desktop machines, and adequate cameras are cheap and widely available. To attain the richest levels of interactivity for distant students, the remote classroom can be as complex (and expensive) as the local classroom requiring multiple cameras, monitors, and input devices. (Franklin, Yoakam, Warren, 1996) (Conway, 1997) Table 3-4 summarizes system requirements:

Equipment	Asynchronous	Synchronous
Camera for teacher	X	X
Camera for remote student	N	X
Camera for local students	O	O
Microphone for teacher	X	X
Microphone for remote student	N	X
Microphone for local students	X	X
Video Monitor for teacher	N	X
Video Monitor for local class	N	X
White board	X	X
Crane camera	X	X
VTT server	X	X
VTT software	X	X

Table 3-4: System requirements: X=Required O=Optional N=Not required

4. Connectivity

The robustness of a VTT system is largely reflective of the type of connectivity used to affect communication. In general terms, there are four types of connectivity currently in use for VTT: dial up connections, networks, Internet/Intranet, and broadcast systems. The "size of the pipe" used to transfer video and audio limits the speed and quality, and is the ultimate constraint to interactivity.

As their name implies, dial up networks are temporary connections that use the public switched telephone networks (PSTN) as a communication backbone for distance

learning. The potential of dial up networks is impressive because of the capabilities of the fiber and terrestrial microwave long haul lines used by the phone companies. The limitation for dial up networks to transport VTT lies in "the last mile" (Kyess, McConnell and Sistanzizadeh, 1995), the twisted pair of copper wires that connect users to their local switch.

At the low end of the capabilities spectrum are standard analog modem users. In the last 10 years the reliable maximum capacity of this service has been pushed to 28.8 Kbps., and despite claims that it was "physically impossible," modems delivering 56 Kbps. are readily available. The meteoric growth in popularity of the Internet, and demand for interactive multimedia on the World Wide Web (WWW) has created a rewarding environment for developers to create tools to deliver video over the public switched telephone network (PSTN). Through the use of streaming technology, 28.8 modem users can currently receive "decent" audio and color video on demand over the WWW.

Within the past two years, there has been an increase in the ability to teleconference over PSTN. "The International Telecommunication Union (ITU) H.324 standard for video conferencing over regular telephone lines is gaining momentum as new players enter the market with compliant products." (Sullivan, 1997) Capable of delivering telephone quality audio and video at rates up to 12 frames per second (fps), PSTN has tremendous potential to become the cheapest and easiest route to VTT.

Another dial up connection that has demonstrated utility for VTT is the Integrated Services Digital Network (ISDN). ISDN is a digital connection that utilizes the installed

base of copper wire at the local level to provide connectivity at speeds not attainable with analog modems. A typical configuration offers two 64 Kbps lines that have proven capable of handling rich VTT albeit with an adequate, but not National Television Standards Committee (NTSC) quality, frame rate (Freeman, 1991). Though it has been widely available for years, ISDN has not been embraced by the general public as it has in the commercial world. (Stallings, Van Slyke, 1994) Because it requires the use of dedicated lines and comparatively expensive modems, ISDN has not experienced the growth enjoyed by other connectivity schemes. Largely unused by the general public, ISDN is currently not a reasonable consideration for delivering distance learning to individual students. Since ISDN does utilize an installed base of wiring, and provides usable bandwidth, it is both perfectly acceptable for classroom to classroom use, and as a method for connecting classrooms to other networks.

The utility of the Internet as a connectivity means was discussed earlier, but it is useful here to discuss it in terms of the way it has shaped current technology. It can be argued that Internet users have created an environment that is characterized by rapacious demand, and intolerance for expensive products. Some of the most powerful products in use on the Web today are distributed free. The demand for high quality multimedia products at low cost by millions of fickle and stingy Web users has been a rising tide for VTT. The huge demand for service, and broad penetration of the WWW has spurred the creation of standards that will provide a solid basis for developers.

The ITU H.323 standard describes "videoconferencing over packet switched networks such as the LAN, corporate intranet, and internet." (Sullivan, 1997) Currently

this mode can only reliably deliver 2-3 fps, but it has considerable advantages over a standard telephone connection; specifically, cost and capacity. Using a variety of schemes, a VTT educator can broadcast video to students in an infinite number of locations. Multicast backbone (Mbone) is “a virtual network overlaying the internet” (Almeroth and Ammar, 1996) that can send a single packet to an infinite number of users, instead of having to address and send an identical packet to each subscriber. The value of this is self evident “...a typical video stream uses the same bandwidth whether it is received by one workstation or twenty...these are powerful tools that extend our ability to communicate and collaborate tremendously. They have already changed the way people work and interact on the net.” (Macedonia and Brutzman, 1994)

While the Internet is a “network” in the purist sense, the term “network” conventionally refers to local and wide area networks (LAN/WAN). LANs and WANs are most frequently applied in corporate and campus environments, and most military bases have one or more networks. While it is conceivable that users could sit at work stations and attend a class given elsewhere on base, the utility of the networks lies in exterior connections. Usually, a LAN is connected to a high speed backbone or to some other type of WAN with enough bandwidth to satisfactorily deliver VTT to individuals or classrooms.

Broadcast technology is currently the “big gun” in the distance learning world in its ability to deliver the most bandwidth. Predictably, it comes with the biggest price. Terrestrial microwave and cable, and satellite links offer exceptional bandwidth capable of handling many simultaneous audio and video signals on demand. Whether broadcast

systems are used to transmit and receive data or full motion NTSC video, there are significant infrastructure considerations to consider beyond the typical local and remote classrooms; satellite transceivers and antennae, or high speed lines to link to terrestrial microwave links are a significant investment. (Nelson, 1997)

The most promising broadcast technology that has sprung to the forefront is the Direct Broadcast Satellite (DBS) system that has recently begun to make inroads on the cable television industry. A constellation of high power geosynchronous satellites offer a high bandwidth option that is not encumbered by the equipment once associated with satellite ground stations: huge antennas with complex aiming requirements. Many regional uplink centers are accessible for local classroom transmissions, and a wide range of vendors offer receive-only systems that are suitable for remote classroom links. One of the immediate descendants of "DirectTV" was "DirectPC" that offers Internet access at downlink speeds of 400 kbits/second, almost 14 times faster than regular dial-up internet access. (Kirkpatrick, 1997) The current downside of this technology is the fact that this is a simplex system. In other words, to achieve a richly interactive environment, remote classrooms are still required to connect by a means other than satellite to communicate with the local classroom.

For all of the technologies discussed, the key consideration to constantly bear in mind is that any of these systems is only as fast as its slowest link. Once data arrive at the backbone, the media is arguably irrelevant; microwave, satellite, fiber or coax all provide ample bandwidth for distance learning. The biggest concern is the first and the last mile of most of these systems, from the local and remote classroom to their nearest

switch, or microwave or satellite transmitter. Table 3-5 shows the relative speeds available through different services.

Technology	Analog/Digital	Speed	Capability
Modem	Analog	33.6 (56 kbits possible)	Good audio, limited video
ISDN Modem	Digital	128 kbits/second	Good audio, satisfactory video
ADSL Modem	Digital	1/6 mbits/second	Good audio/video
Networks/Wire	Digital	100 mbits/second	Good audio/video
Internet (Mbone) T-1	Analog/Digital	1.544 mbits/second	Good sound/video
Networks-Cable	Digital	100 mbits/second	Superior sound/video
Networks-Fiber	Digital	100 mbits/second	Superior sound/video
Satellite	Analog/Digital	Varies	Superior sound/video

Table 3-5. Connectivity speeds. Source: Freeman, Telecommunications Handbook.

5. Asynchronous VTT

Though less rich than the previous methods, asynchronous VTT is by definition less dependent on high-volume backbones than synchronous VTT. Since there is no requirement for real-time interaction between teachers and students, latency, throughput and availability of the backbones are non-issues. Asynchronous VTT may be delivered to LANs or individual students over low bandwidth means over time, or even in fixed media like a CBT course. Two technologies have increased the utility of asynchronous methods: streaming technology, and video servers.

Pioneered by Web developers in search of better ways to deliver multimedia, streaming technology uses buffering to "get ahead, and stay ahead" of video and audio being played on a student's computer. "Playback starts after a short period of data buffering. During playback, data streams from the Internet server to the user, providing essentially real time playback." (Ozer, 1997) By using one of the constantly improving

compression schemes, modem users can currently view news channels like CNN and C-Span over the Internet at 4-6 frames per second with high quality audio. Showing tremendous promise is the video and audio quality that is attainable over ISDN lines at 128 Kbps. Streaming technology means that, currently, individual users can have access to lectures on demand with audio, animation, and low-quality video at dial up modem speeds as low as 28.8 Kbps.

Network video servers are a high-end approach that is suitable for base-wide or dedicated distance learning classroom use. Currently, a single video server on a network is capable of servicing up to 50 individual students at one time. Through the use of large drive arrays, a large number of different lectures, or multiple instances of the same lecture can be accessed by students simultaneously. The utility of this lies in the fact that students are truly free to start and stop a lecture whenever they desire without effecting other students watching the same lecture. As with all of the other technologies, the quality of the audio and video is ultimately a function of the bandwidth available to deliver it to the end user.

Synchronous and asynchronous methods are not mutually exclusive. An economic system would be one where synchronous broadcasts, complete with all of the interactivty with students are captured on some type of recording media and then made available on a networked video server for students who missed the lecture or want to review all or parts of it on demand.

6. VTT Summary

VTT is a mature concept that is a proven replacement for instruction that requires interaction between student and teacher. Despite being less "satisfying" to students, asynchronous methods have also proven to be effective for transferring knowledge, so VTT offers the potential to reuse synchronous broadcasts through tape capture and video streaming. In the following chapter the costs of installing high-tech classroom equipment and procuring connectivity links of sufficient bandwidth will be weighed against costs associated with traditional methods of instruction used in the military. The comparisons will be made using current technology, but the potential of high-quality video over the internet, and the increase in availability of broadcast quality satellite capabilities cannot be ignored because they make VTT a good candidate for MCI's future distance learning efforts.

IV. BENEFIT ANALYSIS

A. MEASURING THE POTENTIAL BENEFITS

In previous chapters the challenges to current Marine distance learning effort were described, as were the technology-oriented solutions being applied to challenges elsewhere. Forming a recommendation for the future path of Marine Corps distance learning requires two steps: the creation of feasible migration paths, and selecting the tools with which to compare them. This chapter describes a method of generating feasible migration paths to satisfy the Marine Corps' future needs, and discusses areas of costs and benefits to aid in comparison of those paths.

B. FEASIBILITY

Generation of feasible migration paths for the Marine Corps requires matching the needs of the service to technology available now and in the foreseeable future. One way to generate feasible migration paths is to develop a formal process to extract and organize all of the information necessary to make an appropriate decision. Gerson (1993) described this type of process as a "comparison heuristic." The process can serve as a decision making framework to examine a problem or class of problems in terms of inputs, outputs and decision rules.

The advantages of creating a formal process for decision making are two-fold. First, simply accepting the constraints of a formal process to address a problem enforces discipline. It causes investigators to think about the criteria and objectives of the project, and causes them to gather data in a systematic manner. Even if the output of the process

is flawed, the information gathered is re-usable in further investigation. Secondly, a formal process offers the ability to examine problems on many levels. For example, in the early stages of a project, simply stating general requirements can be useful in rejecting completely unsatisfactory migration paths, and focusing investigations on potentially feasible solutions. Once several candidate paths are identified, and system requirements refined, the most likely paths can be fed back into the process and examined at an increased granularity. Conceivably, once the requirements are defined, a well crafted decision making process can produce viable solution paths, by feeding it inputs and "turning the crank." Sober (1988) called this "approaching the truth asymptotically," and Gerson (1993) implies that while it may "make us more tired than enlightened," this iterative approach offers the benefit of consistency by applying the same decision making logic to all levels of problem solving. An ideal process is essentially a timeless entity. That is, its mechanisms are not tied to any particular technology or cost scheme, but rather a set of rules used to compare one solution path to another. For example, the utility of the process should not lapse when a new generation of computers processors are developed.

As illustrated in Figure 4-1, the first step in creating the decision making process is to define the future systems requirements. As Jones (1997) outlined there are 5 critical decision factors involved in making technology decisions: system capacity, mix of inputs, mix of outputs, technological focus, and when to start. All of these factors shape the requirements and require discussion.

The capacity, or size of the system, drives the technology required to deliver the product. In the case of MCI, capacity not only includes the number of students participating in all programs, the number and variety of courses offered, but also technical considerations such as simultaneity, latency, synchronicity, surge capacity, accessibility, maintainability, etc.

Mix of inputs is another broad area of consideration. The overarching question is: What is being transferred? At the highest levels of abstraction, knowledge and skills are being transferred. As part of the iterative approach for generating feasible migration paths the requirement to transfer skills and knowledge are reduced to the physical transfer of text, pictures, audio and video images, animation, and simulations.

A feasible migration path will produce both tangible and intangible outputs. Within the mix of tangible outputs are complete courses and programs in either print, CBT or VTT, certified students, and ultimately an adequate supply of properly credentialed candidates for promotion. Among the intangible outputs are knowledge, professionalism, satisfaction, growth, and pride in accomplishment.

The choice of technological focus, that is, whether the system is people/knowledge focused, or equipment centric is largely driven by the mix of inputs and outputs, and also by the subject matter being taught. As previously discussed, different technologies are better suited to different teaching requirements. For example, resident PME courses like Command and Staff, or the Advanced Staff Noncommissioned Officers courses rely more on the interaction between peers and the opportunity for them to share experiences and discuss current issues. "People focused" courses, therefore must

be supported through a system that enables interaction between students. If the system is intended to be a synchronous one, for example, there can be little or no latency. Most of the OSD courses would not benefit from interaction between students, and lend themselves more to individual student techniques like CBT or IBT and therefore are more "technology focused."

The final factor that wants consideration is when to start, or more accurately when to begin developing and phasing in the new migration path. This part of the process requires the most prognostication since it involves making decisions based on the likelihood that things will happen. Generally speaking though, it isn't unreasonable to argue to delay implementing a technology decision if it appears likely that, in time, the cost savings of development or deployment will outweigh the opportunity cost of not having the system online.

C. CREATING A DECISION MAKING PROCESS FOR MCI

Figure 4-1 is a proposed process for generating migration paths for MCI. The first step, defining requirements, has been largely accomplished in previous chapters; the reader knows, generally, the capacity requirements in number of courses and students a new system should be able to service. Other capacity issues like bandwidth, throughput, latency, etc. have also been addressed.

The second step identifies candidate migration paths that are within the range of technical feasibility. Matching requirements to technology is a challenging task because of the many variables involved. Paths can range from maintaining the status quo, to a combination of any of the distance learning technologies discussed in Chapter III,

including CBT, IBT, and VTT in all their associated forms.

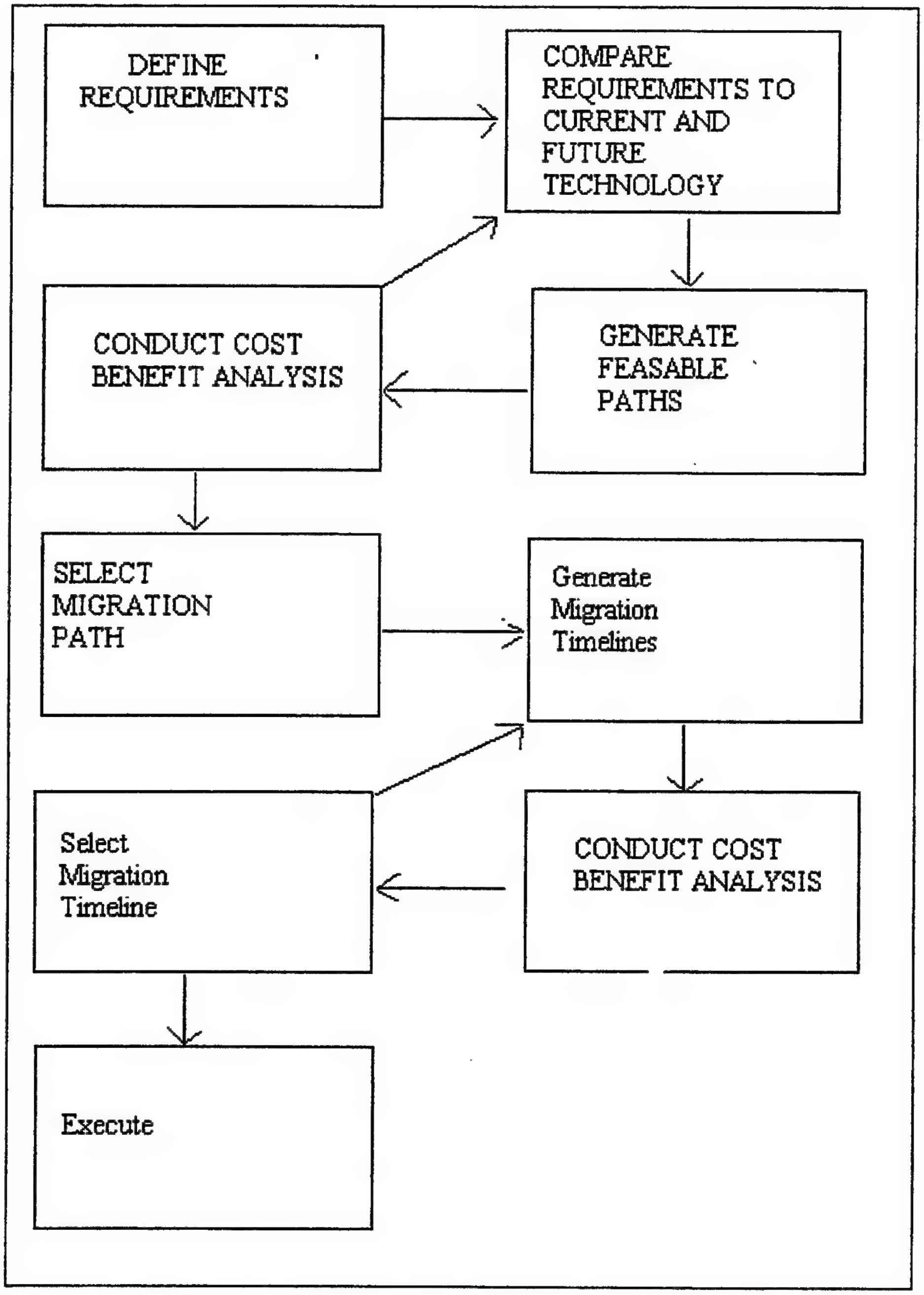

Figure 4-1. Migration Path Decision Making Process.

The third step takes a rough cut at cost benefit analysis and serves the purpose of rejecting paths that are fiscally untenable, and identifying those that may be economically

pursued in the future. For example, today it is technically possible to pass full motion 3-dimension simulations over the internet, but the cost of a system capable of doing it on the scale required at MCI makes this an unfeasible solution for immediate deployment. This option shouldn't necessarily be rejected outright. If it has a high utility it should be investigated to see if it might become economical in the foreseeable future. The process shows an iterative loop going back to step 2 if an insufficient number of candidate paths are generated.

After the migration path is identified, it must be integrated into a time-phased plan. The phasing plan should consider such factors like: Which courses should be converted first? Can the system be deployed incrementally? How long will the existing system be sustained after conversion is complete? What is the backup plan if some expected technology developments fail to occur? Like the individual technologies in step two, the various time-phase plans can now be subjected to CBA with the result being a single time-phased plan that describes a cost-effective migration path from the current to a future distance learning system.

D. PRACTICAL APPLICATION

There are several commercial tools available that can be used in conjunction with the proposed process. One of these, Advisor 2.0, is widely used and a candidate for standardization by the U.S. Air Force Education and Training Command (AETC). (Nelson, 1997) Intrigued by the capabilities of the first generation of Advisor, a staff member of the 82nd Training Support Squadron, Sheppard AFB, worked with the author, Dr. J. Bahlis, to produce a program that meets or exceeds the Air Forces requirements.

(Billings, 1997) Used in support of the recommended process, Advisor is not only useful in the feasibility study, but also has a powerful set of CBA tools.

Appendix A is a summary of the inputs used to generate a sample session created by the author. Though the sample course "8402" is completely constructive, the corresponding Command and Staff course was kept in mind as the author followed Advisor through the step-by-step assessment of education needs. What is immediately obvious is the program's format is conducive to using it as a structured interview tool. Bahlis groups the "interview" questions into four general areas, each covering a different aspect of what he calls "Factors that Impact Media Selection."

The "Regulations" section covers the policies and procedures that are fundamental to the course and course environment: Why does the course exist? Is the course subject matter or material classified? What type of testing is required? The sample course was designed as a public domain course which would require the student to demonstrate skills and knowledge during testing.

The "Organizational" section helps describe the administrative environment of the course: How much time is available to develop the course? What assets are available to do so? It also extracts information about the course objectives, content, and status. The sample course was designed as a revision to an existing course that already had a large portion of its material collected. Consistency in delivery was important and a flexible delivery schedule was required.

The "Training" section of the interview investigates the students and the instructors. What are their backgrounds? Where are they located? Is it essential or just

desirable for them to interact? Is the success of the course dependent on their ability to share experiences with one another? The final part of the interview, "Instructional Needs," tries to capture what type of training environment can be expected: Are students computer literate? Do they have access to PCs? The internet? Can they travel to a VTT classroom or CBT center? The sample course tries to capture the atmosphere of resident a resident PME course, indicating that discussions, role playing, and team exercises are desired. A medium level of change resistance was indicated for both students and trainers to try to generate a conservative estimate.

When the interview is complete, Advisor compares the requirements and matches them to currently available educational techniques. Advisor produces an "effectiveness" score, with 100 percent being an ideal choice. Figure 4-2, is a graphical representation of the results of the example shown in the Appendix.

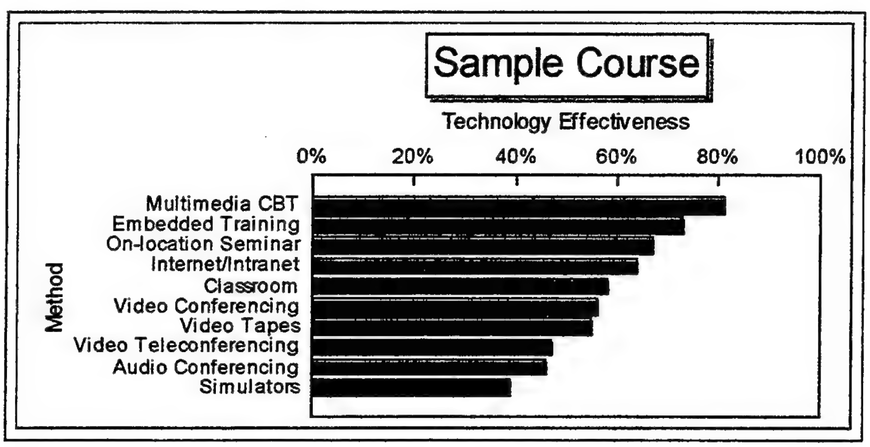

Figure 4-2. Relative effectiveness of potential migration paths.

One of the strengths of Advisor is that it can be used in the iterative phase of both migration path determination and CBA. On demand, Advisor produces a list of reasons why each candidate technology is less than ideally suited for a particular course. In the

sample case for example, Multimedia CBT scores 83 percent because of some deleterious environmental factors like student resistance to change, the fact that the course requires some teamwork, and the fact that student have a limited access to multimedia PCs. Understanding the logic underlying Advisor enables the user to manipulate the variables to generate alternative paths. For example, some of the decision points in Bahlis' logic are purely Boolean. In the sample, a print-based solution was rejected outright because one of the parameters selected was a requirement for audio. If the requirement for audio is negotiable, a correspondence course solution path can be made feasible, with an effectiveness of 60 percent, by changing the value of the variable audio from "required" to "desired."

Some of the decision points are weighted. For example, if the sample case parameters were modified to give the students "full" instead of "limited" access to multimedia PCs and the internet, the effectiveness rating of several paths changes. In this example the effectiveness of CBT increases from 81 to 86 percent. This technique can be used to produce another CBT path; the first would not attempt to mitigate student access to multimedia computers, the second would include some scheme to make computer access universal. The ability to compare the relative merit of these two schemes will be apparent when they are run through CBA.

E. COST BENEFIT ANALYSIS

The comparison of benefits and costs of proposed migration paths is not just good business sense, but required by Senators Clinger and Cohen's 1993 Information Technology Management Reform Act. (Defense Advisory Deskbook, 1997) The

senators' intention was not to force government entities to award all technology purchases to the lowest bidder, but to ensure that those of us entrusted with the public funds are making informed decisions in a disciplined environment. In fact, the act is not specific on which methods to use, just insistent that some type of comparison be done. Since there are no prescribed (or proscribed) methods for doing the analysis, the services are at their discretion to develop systems that ensure all of their needs are met.

The next section investigates the elements of benefits and costs associated with various distance learning technologies and presents them in a form suitable for use in analysis. This section also presents a non-exhaustive list of tangible and intangible costs and benefits associated with distance learning to facilitate the formation of a reasoned comparison between existing and candidate migration paths.

1. Existing Costs

The Marine Corps' current tangible costs of distance learning are far easier to capture than the intangible. Since MCI operations are well documented, the fixed and variable costs associated with the physical plant, equipment, labor, and material can be broken out into a cost per student/hour of instruction. In addition to the MCI operation costs, there is also at least one hidden tangible cost that must be accounted for because it is a cost that has historically been passed on to the customer: time.

The amount of time Marines spend on MCI instruction, when viewed as an opportunity cost, is significant. As previously discussed, units in the fleet administer, distribute, and monitor MCI courses, and students invest time in taking them. Until 30 June 1997, the cost to the government for student's time investment was arguably almost

zero. Marine Corps orders only required units to set aside ½ hour per week for MCI study hall. The time allotted was a token amount in light of the expanding time and effort required to complete the pivotal career courses. Allowing only ½ hour a week for MCI study hall shifted the burden of completing <u>required</u> courses to the Marine's off-duty time, and the opportunity cost to the individual Marine was not negligible. For example, a Marine officer enrolled in Command and Staff was expected to find over 300 hours, or the equivalent of almost nine work weeks of his off duty time over 2 ½ years to complete a course required for promotion. In an era where quality of life is an important issue, this is a huge opportunity cost. With the publication of ALMAR 206/97, CMC has shifted the burden onto units by requiring them to allow all Marines to pursue "non-resident PME during normal duty hours." To give a scale to this burden, CMC cites as reasonable a unit that sets aside "one-half day each week for PME study." With a stroke of the pen, CMC may have seized up to 10 percent of individual units training time.

Intangible costs are difficult to quantify, but certainly have an aggregate impact on decision making, and in part are the impetus for this thesis. Intangible considerations include customer satisfaction, quality of life for service members, the value of a command climate that fosters personal growth, and dedication to the idea that continuing education is a fundamental value. The feedback MCI receives indicates that the current system is not satisfying the customers, and the recent ALMARs have indicated impatience with MCI's ability to resolve its problems. The subject of ALMAR 206/97 is PME, and MCI doesn't even get passing mention.

2. Potential Migration Path Costs

Assessing the absolute cost of candidate migration paths is a slippery subject, but paths generated using the proposed process can be at least be compared relatively. All of the potential paths include the expected costs associated with plant, labor, and material necessary to convert existing courses to their new format. But to each must be added the cost associated with the procurement, installation, training, and maintenance associated with new hardware, software, and the connectivity paths required to deliver distance learning to students.

Additionally, there are intangible costs associated with each candidate path, as well as some associated that any change will generate. For example, with the exception of automating and streamlining some procedures, MCI has been doing business in the same way for over 75 years. Moving to a new set of distance learning techniques will certainly create turbulence that will have at least short term effect on productivity and customer satisfaction. This intangible "overhead" can't be ignored.

The previously discussed distance learning techniques have both unique and common costs associated with them that can be collected using Advisor 2.0. Bahlis has created a tool that does a creditable job of estimating life cycle costs of various distance learning systems. Initially, Advisor gathers general information about a candidate course such as proposed study hours, the number of students expected to use the course annually, expected life of the course, and frequency and depth of revisions.

After collecting generic information about a course, Advisor solicits cost information about the unique costs associated variously with classroom instruction, on

location seminars, print, audio and videotapes, CBT/ICW (on 3 levels from simple to complex), audio and video teleconferencing, and a variety of tutor and user support schemes using the same interview style presented in the feasibility portion. The interviews are exhaustive because Advisor 2.0 solicits cost information regarding the students, instructors, course developers, facilities, maintenance of courses, and hardware that is unique to each potential migration paths. For example, when considering a CBT option, Advisor allows input of cost data on up to 10 development team members, each with a unique number of project work days, salaries, fringe benefit plans, etc. With regard to students, not only does Advisor calculate cost per training hour/day, but also gives the option to include lost opportunity cost for time spent away from other duties.

Appendix B is a summary of all of the elements that go into the final cost summary generated by Advisor. In a sample problem provided with Advisor, a CBT alternative is compared to an existing resident course. Advisor generates tabular representations of the inputs and outputs, and graphical representations of the results that show return on investment(ROI), payback period, and the break-even point. Figure 4-3 is an example of break-even analysis between a traditional classroom course and a CBT solution.In the sample problem the CBT alternative breaks even at approximately the 17 month point, after absorbing the development and startup costs, and thereafter has a positive return on investment.

Figure 4-4 is a pie chart showing where the costs associated with a particular approach are allocated. When using the iterative refinement process to develop migration paths, it is beneficial to be able to quickly identify what is driving a particular path's cost.

In the example, the complexity of the course, and planned frequent revisions account for a large portion of the costs.

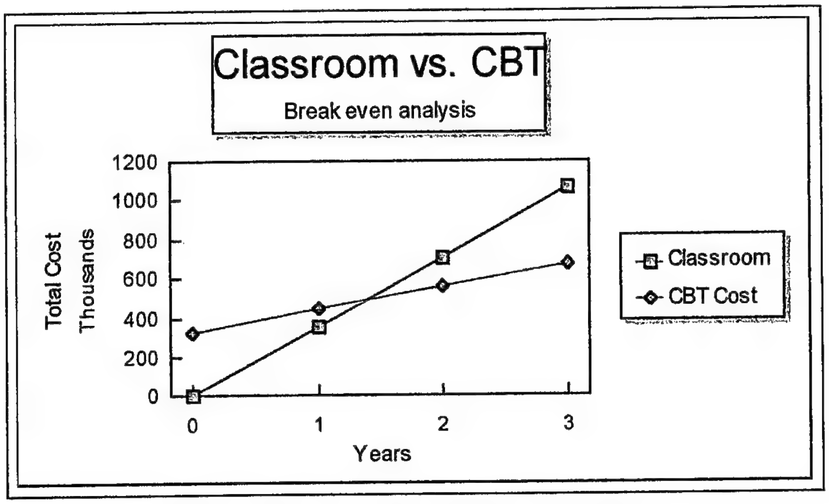

Figure 4-3. Source: Advisor 2.0 Demo.

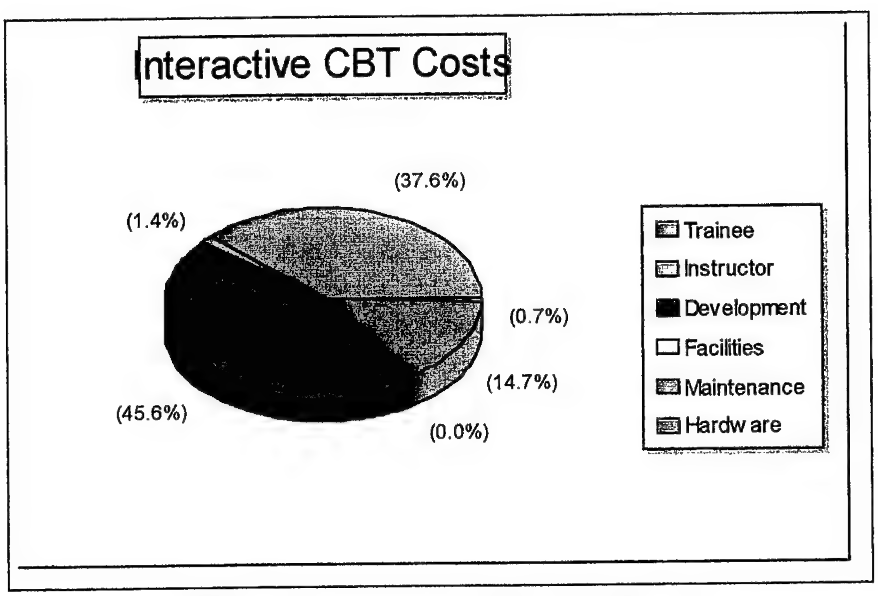

Figure 4-4. Source: Advisor 2.0 demo.

Once again, understanding the logic behind Advisor allows the user to generate multiple paths, or refine individual ones by manipulating the variables. If the sample alternative is

too costly, the pie chart indicates that some money could be saved in the area of course development. Reducing development cost by reducing the amount of multimedia content might create an acceptable alternative.

3. Potential Migration Path Benefits

If education and training were sciences and not arts, it would be easy to establish measures of performance (MOP) with which to compare candidate migration paths. Instructions-per-second and bit-error rates are infinitely more comparable between systems than ethereal ones associated with the transfer of knowledge and skills. As presented earlier, the various technological options have proven to be comparable to classroom-based education in regards to knowledge and skill mastery, retention, and application. Therefore, starting with an "all things being equal" assumption vis-a-vis course utility, the comparison of benefits tends to focus on less tangible measures. Hoffman (1994) offers three guidelines for assessing the potential benefits of technology:

a. "It can help reduce costs or increase profits of an existing activity."

Tangible costs savings between the current system and proposed paths can be calculated with existing cost data, however projected cost estimates for technology procurement are usually notoriously underestimated. Frew(1997) suggests it is not unreasonable to argue that is impracticable to compare the current cost of doing business with the potential costs and benefits of candidate migratory paths. That doesn't mean it shouldn't be done, if only get an order of magnitude cost for candidate technologies. For example, reasonable comparisons can be made between the cost of

printing, storing and mailing paper course work vis-a-vis the cost of printing, storing and mailing CDs, or storing a course on a web server and transmitting via the Internet . The most interesting benefits in each path may be intangible. For example, many studies have indicated a significant opportunity exists to reduce the amount of time spent on course work via electronic distance learning over traditional methods. If time is accounted as an opportunity cost, reducing course completion time by a median 30 percent is a huge windfall not only in manpower dollars, but also for quality of life. Advisor 2.0 allows the operator to set a varying "compression factor" to account for this, with a recommended value of 30 percent.

b. "It can be an integral part of a redesigned business process."

ALMAR 206/97 announces a change in the way the Marine Corps does its distance learning business and indicates "the responsibilities of the College of Continuing Education will evolve as emerging distance education technologies narrow the gap between resident and nonresident programs." Clearly, CMC recognizes the intrinsic value of technology and views it as a benefit to whatever new system evolves, the weight of which is probably CMC's prerogative to assess.

c. "It can support the future of the business, which is to say business strategy and vision."

Arguably, Krulak is the first technologically oriented CMC, and this is reflected in the Commandant' Planning Guidance. His personal cachet has given credibility to many new concepts: Marine Mail, an e-mail system designed to collect good ideas directly from Marines of all ranks and occupations; Marine Doom, a popular

3-D computer game modified to present realistic infantry scenarios, and most significantly, the founding of the Marine Corps Warfighting Lab (originally the Commandant's Warfighting Lab). A technologically advanced distance learning system clearly supports the vision of the current Commandant who states:

> ... I expect trainers and educators to make maximum use of interactive training and education. Simulation and associated technologies and the use of video tapes or video teleconferencing with live transmission to classrooms across the country, to afloat forces, and to forward deployed forces are only representative examples of what I expect. Further, tactical decision games can be as effective at HQMC as in the operating forces in fostering judgment and decision making by leaders at every level. These games help keep these intellectual skills honed even while away from the fleet.

F. SUMMARY

The comparison of costs and benefits between the existing system and potential migration paths is a challenging and inexact science. If a technological solution to the Marine distance learning challenge is supportable as it appears to be under Hoffman's guidelines, then the ITMRA requirements may serve more utility as a means to ensure that the path that is selected is the most efficacious one. Using a heuristic to systematically define requirements and generate and compare migration paths helps to enforce discipline in the comparison between options that can be externally dissimilar. Finally, there are some thorough and efficient tools already in use in the DoD that have proven their utility and should be utilized as decision support systems when addressing the Marine Corps' distance learning needs.

V. FINDINGS AND RECOMMENDATIONS

A. FINDINGS

This thesis has investigated historical and current applications of technology to distance learning. The Marine Corps' correspondence program was examined vis-a-vis its ability to support the pivotal role distance learning plays in a Marine's career. Current and upcoming technologies being applied by other services, universities, and industry to distance learning were investigated, and a non-exhaustive list of their relative costs and benefits provided. Finally, a process for matching the needs of the Marine Corps to the technologies available was proposed.

While the literature research, site visits, interviews, and conferences the author attended provided sufficient information to answer the research questions, the transitory nature of modern distance learning was repeatedly manifested during the course of the research. The literature search was distinctly nontraditional since it is difficult to find published information that addresses the subject in a contemporaneous manner; even periodicals tended to be overly general. Background information on education philosophy, and some early papers on the efficacy of CBT were available in print, but daily searches of the World Wide Web proved to be the most prolific source of information on distance learning.

The dynamic nature of the information available via the Internet is representative of the state of the art. It is a growing field that appears to have grown by an order of magnitude during the course of the author's research. During this period the Marine Corps itself has taken at least one step forward with the publication of ALMAR 206/97

establishing the College of Continuing Education. The recent efforts by the Marine Corps to reorganize its distance learning efforts are complimentary to the answers to the research questions below.

1. What current and future technologies are being applied to distance learning?

a. Asynchronous Methods

As discussed in Chapter III, a broad range of technologies are being applied to distance learning. The span of technologies being employed to asynchronous distance learning begins at the single user level. Like students in traditional correspondence course, most asynchronous distance learning students work alone. Now, however, they utilize the ubiquitous PC to participate in a less linear, more interactive form of education in the form of CBT. Students use multimedia PCs to quickly move through courses on paths of their own choosing. The courses, usually on a delivered on CD, can be as simple as text-based lessons supported by sounds and graphics, or challenge the student with the opportunity to experiment in advanced simulations or play out scenarios through gaming.

The next level of technology being applied to asynchronous distance learning is networking. Whether students dial in to a network or an Internet service provider, are permanently attached to a LAN, or in a dedicated CBT classroom, network connectivity allows students access to more complex courses. Mass storage and high bandwidth connectivity offer the ability to view lectures stored on video servers, and an enhanced ability to communicate with course administrators. Network solutions to

asynchronous distance learning also give course administrators more control over the access to and content of the courses they provide.

b. *Synchronous Methods*

The most popular synchronous method is VTT. Video places great demands on bandwidth, and it is available bandwidth that ultimately determines the richness of the interactive environment. The leanest synchronous environments only allow one way video, and students interact only through voice or e-mail. Lean VTT can be delivered over the Internet with a limited capital investment. Faster modems and processors, and more efficient coding schemes promise the possibility of richer distance learning at a low cost. The richest environments allow the teacher and all of the students the ability to see one another. Full duplex video and audio between local and remote classrooms can be attained over high speed networks, dedicated phone lines, and satellite connections.

2. Which government and industry organizations have successfully employed distance learning to augment/replace traditional training methods?

Kemske's (1996) survey focusing on Computer Based Training (CBT) showed broad penetration of technology oriented distance learning into almost every area of US business, government, and education. Inexpensive, highly capable PCs combined with powerful authoring tools have made CBT a popular training alternative in industry and government. The Air Force has established training units dedicated to the production of CBT, and has successfully converted the Air Command and Staff College to CBT.

Universities are leading advocates of IBT, capitalizing on their existing networks to augment resident courses, and in many recent cases, deliver courses solely via the Internet. The University of Arizona, Oregon State, and University of Illinois are major centers of IBT activity. University entities like the Sloan Center for Asynchronous Environments (SCALE) at the University of Illinois (Urbana-Champagne) is representative of the serious view progressive institutions are taking of this phenomena. Large universities are quietly plunging into synchronous and asynchronous distance learning via campus wide networks, broadcast networks, and the Internet. The United States Air Force should also be included in this group. The Air Education and Training Command has embraced CBT and VTT and has been producing quality courses for several years. At the very far edge of the envelope are people like Doug Becker of Sylvan Learning Systems, who plans to build a virtual university using technology to give students access to the best lecturers around the world without the expense of bringing either the students or professors into residence. (Becker, 1997)

3. What are the best metrics to calculate savings (if any) organizations realize after implementing technology oriented distance learning?

Despite the good intentions of ITMRA, the only accurate comparison between old and new systems will occur after the new system has been fielded, and the bills paid. However, the ITMRA requirement to conduct cost benefit analysis instills discipline on the procurement cycle that, in itself, intrinsically adds value. When trying to gauge the payback potential of candidate systems, both tangible and intangible costs and benefits must be considered.

a. Tangible Costs and Benefits

Organizations considering investing in an electronic solution to distance learning will have a difficult time predicting a precise return on investment. Historically, organizations that attempt to forecast tangible costs fail miserably. (Frew, 1997) There are some tools however, that can help planners systematically assess the costs associated with migration to a new system that can help increase the accuracy of projections.

A training decision support system, called Advisor 2.0, was designed to help organizations extract information about their existing systems and the costs associated with developing and implementing new, technology-based, distance learning systems. While Advisor is exhaustive in its examination of cost centers, the accuracy of the operators estimates is what will drive the overall value of its CBA.

Tangible costs include all of the start up costs associated with new systems: equipment, installation, and training, plus the cost of developing new courses or converting old courses to the new system. The payoff in tangible terms can be found in the significant reduction in the labor and physical plant required to run the system. Electronic media means a reduction in the consumption of print, paper, and postage, and costs associated with shrinkage due to loss, shop wear, or obsolescence. The most important payoff that is currently not accounted for is possibly a large reduction in student hours spent taking courses. Since the Commandant has directed that units absorb the time for PME in their training schedules, the time compression that the various technologies offer could account for a considerable savings.

b. Intangible Costs and Benefits

Change causes turbulence. MCI has evolved glacially over the last 75 years and, despite its drawbacks, works. Migrating to a new system, particularly with the fate of Marines' careers in the balance, will be costly in terms of the way the change affects Marines. Turbulence related to change can be mitigated through careful management, but not erased. The impact on morale from fear of the unknown and resistance to change can't be accounted in a spreadsheet, but must be considered.

Depending on the goals of the organization, some of the greatest rewards to be realized by implementing a new distance learning system might be difficult to quantify into a cost benefit analysis. Hoffman (1994) offers an alternative view that suggests that value of any new system should also be viewed in light of its contribution to redesigning business processes, and its support of the organization business strategy and vision. The Marine Corps is redesigning its distance learning process, and the technologies discussed in Chapter III are all viable candidates for consideration. The Commandant has described his vision for the future Marine Corps, and the leveraging of technology over manpower is central to it. Currently, Marines participate in an archaic system that in some cases in embarrassingly out of date. The Command and Staff College Nonresident course, for example is written as if the Soviet Union still exists. A technologically advanced distance learning system would ensure that anomalies like this, which would never be tolerated within resident instruction, aren't inflicted on students at a distance.

4. Which distance learning methods/technologies best match the future needs of the Marine Corps?

Specific recommendations are included below, but generally there are two answers. First, the Marine Corps will always have OSD courses that don't rely on a high degree of interaction among students to be successful. The most economical approach for these courses therefore, is one of the asynchronous approaches such as CBT or IBT. While IBT is probably the most economical and easy to manage, the expeditionary nature of the Marine Corps will probably require that courses be stored remotely on at least some student's computers. Regardless, the authoring tools now available can economically put the power to create high quality asynchronous courses in the hands of subject matter experts.

Secondly, there is no reason to expect a significant increase in the percentage of Marines offered the opportunity to attend resident professional military education so Nonresident PME must be a part of any new system. Unlike OSD, resident PME courses rely heavily on the exchange of ideas and experiences between students and teachers to complete the learning experience. It should be the goal of any new PME distance learning system to try to capture that colleaguesmanship. To do so requires a synchronous system with as rich an environment as can be afforded. Marines fortunate enough to be stationed at or near bases should be able to join with classmates in VTT classrooms to participate in lectures given from the various schoolhouses. Deployed Marines or those on independent duty will have to reasonably expect a leaner environment, but at a minimum should be able to synchronously view the lecturer, and participate in questions

or discussions with classmates. This two-level approach requires the simultaneous use of a broadcast or network connection to remote classrooms, and perhaps an Mbone broadcast for the individual students.

B. RECOMMENDATIONS

The message of this thesis should be a clear endorsement for pursuing a technological solution to the Marine Corps' distance learning challenge with the eventual goal of completely retrenching the paper-based MCI system. The recommendations outlined are in three general areas: Structural, Technical, and Philosophical. It has been the intention of this paper to provide a framework for examining these specific systems in regard to appropriateness, feasibility, and costs and benefits.

1. Structural Changes

Whether or not the MCI can be the agent of change for a new generation of Marine Corps distance learning is a subject for debate. The Marine Corps itself matches perfectly Bushe and Shani's (1991) description of an organization whose "...characteristics that lead to highly efficient, predictable performance get in the way of the learning need to sustain that performance." Bush and Shani's solution to this paradoxical problem is the establishment of a parallel learning structure sufficiently funded and chartered to experiment, develop, and aid in implementation of "system-transforming innovations." That structure might already be in place with the timely establishment of the College of Continuing Education (CCE) in Quantico, VA. Positioned to assist MCU is the Marine Corps Modeling and Simulation Management

Office (MCMSMO). Also located in Quantico, MCMSMO has been independently investigating technological distance learning solutions since 1995. (McCaffery, 1996)

Regardless, MCI is fully engaged in the day-to-day duties of administering the existing correspondence program and highly likely to be resistant to major structural changes. Since MCU has been fully chartered with responsibility for PME, it is logical to suggest that MCI, in whatever form it ultimately takes, be subordinated to the Director of MCU. If MCU can absorb the administrative tasks associated with administering the Marine Corps distance learning effort, and the CCE is given full responsibility for PME, that would leave MCI only responsible for OSD courses, which is where it started 75 years ago.

There is also a requirement that a major business process reengineering (BPR) take place within the system and during structural change is the time to do it. Many tasks that are justifiable under the current system can be eliminated under a new system. For example, as discussed in Chapter I, MCI currently tracks a Marine's progress from course registration through certification. Assumedly, the objective, is to ensure the student completes the course, passes the test, and gets credit for the course in a timely manner. All or most of the administrative tracking that takes place adds no value to the system and should be eliminated. A Marine who demonstrates course mastery by passing a test should be credited. The Air Force does not track individual students until they show up at a base testing center and say: "I'm here to take the test." (Nelson, 1997) Many steps in the current process can be streamlined or eliminated, allowing MCI or its successor to focus on quality course creation and delivery, and not administration.

2. Technical Changes

The division of courses into OSD and PME is a good entry point for making recommendations about technological changes. OSD courses, as discussed earlier are oriented towards transferring basic skills and knowledge closely associated with soldierly skills. The nature of these courses lend themselves most closely to CBT/IBT education. Today's CBT authoring tools offer affordable integration of multimedia, to include animation and full-motion video, in a highly interactive environment. The courses they produce can be both highly efficient while offering more flexibility for the student by using branching and remediation, as well as context sensitive feedback. Even very complex technical subjects can be demonstrated and practiced safely through simulation.

During the writing of this thesis MCU has already taken the first evolutionary step, with some lectures from resident PME courses being offered by VTT. The degree of complexity of PME courses, as well as the value added by interaction between students indicates that the VTT model is probably the best choice for delivery. The ideal choice would be to allow every non-resident student the opportunity to participate in a synchronous virtual school house, but in reality, some asynchronous capability will have to be maintained because of the diverse and dispersed audience these courses are aimed at.

The most daunting decisions associated with converting from the current system surround the sizable upfront investment in technology. Like all technological investments there are risks associated, but those can be mitigated in emphasizing the purchase of open architecture systems, and the use of nonproprietary hardware and software. Kempske's

(1996) survey, and the literature indicates that the trends in CBT are heading toward PC-based solutions with the Internet becoming the choice method of delivery and this is the way the Marine Corps should go as well.

Every Marine must be given the opportunity to access whatever medium the Marine Corps chooses to adopt, and the current base of administrative and tactical computers are not enough to support the requirement. Therefore, Marine Corps Base (MCB) level distance learning centers should be created at every post and station that include both CBT/IBT and VTT classrooms. Since it is unreasonable to require Marines to travel for OSD style courses on large bases, smaller, less complex satellite CBT/IBT centers should be established in the same way that area gymnasiums are. If base distance learning centers are equipped with video servers, students at area distance learning centers can still participate in VTT courses, albeit in a leaner or asynchronous environment.

The new system should also offer a dial up capability so that Marines can participate from home. Whether accessible via the Internet through an ISP, or a direct dial up connection to the base learning center network, the new system should offer those Marines with computers of their own easy access to mitigate crowding at the centers.

3. Philosophical Changes

Gery's comment on distance learning is worth repeating at this point:

"At the end... learners will have learned what they damn well please. And its our job to...create the motivation to learn."

The motivation of Marines to learn already exists, its just been beaten into submission by a 75 year old system that's elevated importance has not been matched with investments in its capabilities. Removing the onerous and frustrating aspects of distance learning should be a guiding principal of this effort. The idea however, that we must be able to reach every Marine, all the time, by "carrier pigeon" if necessary, could be self defeating. Any system will never be absolutely equitable in the distribution of opportunity or assets. The administration clerk who works office hours and has a networked PC on his desktop will always have more access to distance learning than an infantryman whether its a correspondence course or IBT. If the Marine Corps embraces a range of technological solutions to distance learning, reorganizes or creates new organizations to provide it, and provides adequate, convenient distance learning centers aboard bases and at sea, that gap can be closed.

The Commandant has provided the incentive for Marines to participate in distance learning; nonresident education is mandatory if a Marine wants to get promoted The system we currently have has served well over the years, but has not grown to match the requirements put upon it. Today, it is technically and economically feasible for the Marine Corps to completely retrench our distance learning system and provide Marines with interesting, effective, and efficient distance learning. To make the bold structural changes and capital investments required to start this revolution would reinforce the claim the Marine Corps has always made about its commitment to education.

LIST OF REFERENCES

ALMAR 339/96, *Enlisted Professional Military Education (PME) Requirements for Sergeants Through Gunnery Sergeant Eligible for Promotion*, 20 Sep., 1996

ALMAR 458/96, *PME Requirements for the CY-96 Reserve SNCO Promotion Board*, 23 Dec., 1996.

ALMAR 102/97, *Completion of Marine Corps Institute (MCI) Program Fixes*, 31 Mar., 1997.

ALMAR 206/97, *Officer PME and the College of Continuing Education*, 30 Jun., 1997.

Almeroth, K. C., and Ammar, M. H., "Collecting and Modelling the Join/Leave Behavior of Multicast Group Members On Mbone," *IEEE Proceedings of HDPC-5 '96*, 1996.

AME (Australia Multimedia Enterprise), *Digital Versatile Disk*, Sydney, Australia, 1996. (http://www.amme.com.au/dvdbackground.html)

Anderson, Jon R., "Speeding Majors Through PME," *The Navy Times*, 3 Feb., 1997.

Anderson, Jon R., "Easing the Burdens of Command and Staff Students," *The Navy Times*, 14 Jul., 1997.

Becker, D., *Address to the International Distance Learning Conference*, Alexandria, VA, Mar. 25, 1997.

Billings, K., Interview with Author, Wichita Falls, TX, 24 May, 1997.

Birinato, S., "Gigabit. What's Next?" *PCWeek*, 4 Aug., 1997.

Brutzman, D. P., and Macedonia, M. R., *Mbone provides Audio and Video Across the Internet*, Monterey, CA, 1994.

Bushe, G. and Shani, A. B., *Parallel Learning Structures: Creating Innovations in Bureaucracies*, San Louis Obispo, CA, 1991.

Cerf, V. and Kahn, R., *A Protocal for Network Intercommunications*, 1974.

Chu, G., and Schramm, W. *Learning from Television: What the Research Says*, Washington, DC, 1967.

Conway, K., *Master Classrooms: Classrooms Designed with Technology in Mind*, Chapel Hill, NC, 1997.

Crawford, A., and Suchan, J., *Understanding Videoteleducation: An Overview*, Monterey, CA, 1996.

Daft, R., Lengel, R., and Trevino, L., "Message Equivocality, Media Selection, and Managerial Performance: Implications for Information Systems," *MIIS Quarterly, Volume 11*, 1987.

Defense Advisory Deskbook, *ITMRA*, Washington, DC, Mar. 1997.

Dorbolo, J., Correspondence, Corvalis, OR, 1997.

Franklin, N., Yoakam, M., and Warrin, R., *Distance Learning: A Guide to System Planning and Implementation*, Indiana University, 1996.

Fletcher, J., "Does This Stuff Work? Some Findings from Applications of Technology to Education and Training," *Proceedings of Conference on Teacher Education and the Use of Technology Based Learning Systems*, Warrenton, VA, 1995.

Freeman, R. L. , *Telecommunications Handbook, Third Edition*, New York City, NY, 1991.

Frew, B., *Naval Postgraduate School Lecture to IS-4182*, Monterey, CA 14 Jul., 1997.

Garrison, R., and Noreen, E., *Managerial Accounting, 7th Edition,* Burr Ridge, IL, 1994.

Georgia Tech Research Corporation, *Executive Summary, 1997 Internet Survey*, Atlanta, GA, 1997.

Gerson, E., *A Classifiction of Heuristics*, Tremont Research Institute, 1993.

Gery, G., *Making CBT Happen*, Boston, MA, 1987.

Graves, W. H., *Towards A Distributed Learning Inforstructure*, Calgary, Alberta, 1994. (http://www.iat.edu/publications/graves/graves3.txt)

Heinl, R., *The Marine Officer's Guide*, Annapolis, Maryland, 1977.

Hoffman, G., *Technology Payoff*, Burr Ridge Illinois, 1994.

Jones, C., *Naval Postgraduate School Lecture to IS-3112*, Monterey, CA 12 May, 1997.

Keegan, D., *The Foundation of Distance Education*, Bekenham, UK, 1986.

Kemske, F., *1996 Computer-Based Training Report*, Hingham, MA, 1996.

Kirpatrick, K., *Internet Service Providers Look to the Stars*, 1997.
(http://www5.zdnet.com/cshopper/content/9706/cshp0077.html)

Krulak, C. C., *The Commandant's Planning Guidance*, Washington, DC, (undated).

Kulik, J., *Meta-analytic Studies of Findings in Computer-Based Instruction*, Hillsdale, NJ, 1994.

Kyess, P., McConnell, R. and Sistanizizadeh, K., "ADSL: A New TwistedPair Access to the Information Highway," *IEEE Communications Magazine*, Apr., 1995.

Maitland, C., *Packet Switching Made Simple*, East Lansing, MI, 1996.
(http://www.tc.msu.edu/tc960/PACKET.HTM)

Marine Corps Institute, *MCIAS Brief*, Washington, DC, Feb., 1996.

McCaffery, S., *Emerald Force*, Quantico, VA, 1996.
(http://138.56.15.33/emerald/emforce.html)

McCracken, E., *Superintendent's Guest Lecture Series*, 1996.

Mood, T., *Distance Education, An Annotated Bibliography*, Englewood, CO, 1995.

Navy Office of Training and Technology, *Interactive Courseware*, San Diego, CA, 1996.
(http://ott.sc.ist.ucf.edu/1_2/icwcats.htm)

Navy Times Staff, "50 Percent Shot at Schools", *The Navy Times*, 14 Jul., 1997.

Nelson, G., Interview with Author, Wichita Falls, TX, 24 May, 1997.

Orfali, R., Harkey, D., and Edwards, J., *Essential Client/Server Survival Guide*, John Wiley and Sons, 1994.

Orlansky, J. and String, J., *Cost Effectiveness of Computer-based Instruction in Military Training*, Arlington, VA, 1977.

Ozer, J., "Introduction to Streaming Multimedia," *Publishing Digital Video*, 1997.
(http://www.doceo.com/articles/streamin.html)

Phillips, T., *Command and Staff College Non-Resident Program Discussion Group*, Monterey, CA, 1997.

Salazar, R., *Using Audio on the Internet for Training Purposes*, Fort Lauderdale, FL, 1996.

Salzman, M., *Check Out DVD!!*, San Francisco, CA, 1997. (http://helios.acomp.usf.edu/~msalzman/)

Sober, E., *Reconstructing the Past: Parsimony, Evolution, and Inference*, Cambridge, MA, 1988.

Stallings, W. and Van Slyke, R., *Business Data Communications*, Upper Saddle River, NJ, 1994.

Sullivan, K. D. , "Video Conferencing's Public Debut," *PC Week*, May 19,1997.

Wetzel, C., Pugh, H., Van Matre, N., and Parchman, S., *Video Teletraining of A Quality Assurance Course with a Computer Laboratory*, San Diego, CA, 1996.

APPENDIX A. FEASIBILITY STUDY PRODUCED BY ADVISOR 2.0

BASIC INFORMATION

Date:	7 -7 -1997
Course Title:	Command and Staff College
Course Number:	8402
Course Manager:	Major Michael Broihier
Operator:	Major Michael Broihier
Date of Last Audit:	7 -7 -1997

ENVIRONMENT

REGULATIONS

Regulations

Reasons for Course:	Combination
Classification:	Public domain
Testing Requirements:	Skill/Knowledge

ORGANIZATIONAL

Administrative

Development/Revision Time:	Adequate
Trainers/SME Availability:	Adequate
Reference Material Availability:	Accessible
Consistency:	Important
Delivery Time:	Flexible
Scheduling:	Meets demand
Data Collected:	Large

Course

Objectives:	Job performance
Content:	Specific
Status:	New

Trainees

Size:	>1000
Location:	Scattered
Value of Trainees Time:	Very high

TRAINING I

Trainers	
Delivery Method:	SME
Data Collected:	All of the above
Resistance to Change:	Medium
Trainees	
Team Work:	Sometimes
Evaluation:	Skill/Knowledge
Course	
Relevance:	Prerequisite
Content:	All of the above
Referred To:	Regularly
Expected Life [years]:	> 5 years
Stability [%]:	5% to 10%
Urgency:	Moderate
Length [hours]:	> 35 hrs

TRAINING II

Content	
Hands on Exercises:	Desired
Personal Safety :	No
Equipment/Data Integrity:	No
Real Equipment:	Required, available
Real Equipment Simulation:	Moderate
Processor in Real Equipment:	Not applicable
Guided Discussions:	Desired
Role Play :	Desired
Teaming Exercises:	Desired
Audio:	Required
Full Motion Video:	Desired
Still Images:	Required

INSTRUCTIONAL

Trainees	
Receptive to Computers:	Yes
Reading Ability:	Adequate

Resistance to Change:	Medium
Motivation:	Medium
Skill/Proficiency:	Diverse
Ability to Travel:	Limited
Access to Computer:	Limited
Access to Multimedia PC:	Limited
Access to Video Conferencing:	Limited
Access to Internet/Intranet:	Limited

Content

Learning Objectives:	Knowledge/Skill
Self Pacing:	Most of course
Share Experiences:	Desired
Apply Knowledge:	Combination

SUMMARY

Delivery Methods/Media	Scores (%)
Multimedia CBT	81
Embeded Training	73
On-location Seminar	67
Internet/Intranet	64
Classroom	58
Video Conferencing	58
Video Tapes	56
Video-Tele Conferencing	55
Audio Tapes	47
Computer Conferencing	46
Audio Conferencing	39
Simulators/Virtual Reality	0
Intelligent Tutorial	0
EPSS	0
Customized CBT	0
Hypermedia	0
Hypertext	0
Off-the-Shelf CBT	0
Print	0
Simple CBT	0

APPENDIX B. TRAINING COST ANALYSIS PRODUCED BY ADVISOR 2.0

Training Cost Analysis - General

Course Title:	Sample Course
Course Number :	123456
Geographic Location:	Worldwide
Working Hours per Day [hours] :	7.5
Expected Life of Course [years] :	3.0
Revision [per year] :	10.0 %
Number of Trainees [over life of course] :	225
Number of Trainees [per year] :	75

Training Cost Analysis - Classroom

Course Title :	Sample Course
Course Number :	123456

BASIC

Course Length [hours] :	45.0
Classroom Section of Course [hours] :	45.0
Number of Trainees [per class] :	15
Number of Instructors [per class] :	2.0
Frequency of Course [per year] :	5
% of Trainees that Travel :	100.0 %
% of Instructors that Travel :	0.0 %
Trainee Travel Length [days] :	2.00
Instructor Travel Length [days] :	0.00
Days Required by Trainee [per class] :	8.0
Days Required by Instructor [per class] :	6.0
Number of Trainees [per year] :	75.0
Number of Instructors [per year] :	10.0

Training Cost Analysis - Classroom

TRAINEE

Trainee Annual Salary :		$50,000
Fringe Benefits Factor :	x	25.0 %
Annual Trainees Costs : =		$62,500
Annual Productive Days :	/	222
Trainee Daily Salary : =		$282
Lost Opportunity Costs:		$0
Trainee Per Diem :		$120
Trainee Travel Costs:		$1,000
Class Length [days]:		8.0
Total # of Trainees [per year]:		75
Annual Trainees Costs		
. Salary:		$169,200
. Lost Opportunity:	+	$0
. Per Diem:	+	$72,000
. Travel:	+	$75,000
Miscellaneous Costs:	+	$0
Total Trainee Costs [per year]:	=	$316,200

Training Cost Analysis - Classroom

INSTRUCTOR

Instructor Annual Salary:		$65,000
Fringe Benefits Factor:	x	25.0 %
Annual Instructor Costs:	=	$81,250
Annual Productive Days:	/	222
Instructor Daily Salary:	=	$366
Lost Opportunity Costs:		$0
Instructor Per Diem:		$0
Instructor Travel Costs:		$0
Consulting Fees [per class]:		$0
Class Length [days]:		6.0
Total # of Instructors [per year]:		10.0
Annual Instructors Costs		
. Salary:		$21,960
. Lost Opportunity:	+	$0
. Per Diem:	+	$0
. Travel:	+	$0
Miscellaneous Costs:	+	$0
Total Instructor Costs [per year]:	=	$21,960

Training Cost Analysis - Classroom

DEVELOPMENT

	S M Expert		Clerical
Annual Salary :	$65,000		$28,000
Fringe Benefits :	25.0 %		25.0 %
Annual Cost :	$81,250		$35,000
Productive Days :	222		222
Daily Salary :	$366		$158
Days on Project :	50		2
Total Costs :	$18,300		$316
Total Personnel Costs :			$18,616
Contracting Costs :		+	$0

Production and Material Costs	:	+	$1,000
Evaluation Costs	:	+	$0
Miscellaneous Costs	:	+	$4,000
Total Development Costs :		=	$23,616
Amortization:		/	3.0
Development Costs [per year]:		=	$7,872

Training Cost Analysis - Classroom

FACILITIES

Annual Facilities Costs	:		$0
Course Allocation [%]	:	x	0.0 %
Facilities Cost for Course	:	=	$0
Rental Fees [per class]	:		$500
Total Facilities Costs [per year]	:		$2,500

Training Cost Analysis - Classroom

MAINTENANCE

Administrative		S M Expert
Annual Salary	:	$65,000
Fringe Benefits	:	25.0 %
Annual Cost	:	$81,250
Productive Days	:	222
Daily Salary	:	$366
Days on Project	:	6
Total Costs	:	$2,196

Total Administrative Costs: $2,196

Consumable Material

Course Material Costs [per trainee]	:		$20.0
Number of Trainees [per year]	:	x	75
Total Course Material Costs	:	=	$1,500
Miscellaneous Costs	:	+	$100
Total Material Costs	:	=	$1,600

Revision

Development Costs [per year]	:		$23,616
Revision Factor [per year]	:	x	10.0 %
Total Revision Costs [per year]	:	=	$2,362
Total Maintenance Costs	:		$6,158

Training Cost Analysis - Classroom

HARDWARE

Equipment and Remodelling Costs	:		$0
Course Allocation	:	x	0.0 %
Equipment Cost for Course	:	=	$0
Expected Life of Equipment	:	/	3.0
Equipment Cost [per year]	:	=	$0

Training Cost Analysis - Classroom

SUMMARY

			Total costs per year			
			Direct	Indirect	Total	[%]
Trainee Costs	:		$147,000	$169,200	$316,200	89.1 %
Instructor Costs	:	+	$0	$21,960	$21,960	6.2 %
Development Costs	:	+	$1,669	$6,203	$7,872	2.2 %
Facilities Costs	:	+	$2,500	$0	$2,500	0.7 %
Maintenance Costs	:	+	$2,101	$4,057	$6,158	1.7 %
Hardware Costs	:	+	$0	$0	$0	0.0 %
Training Costs [per year]	:	=	$153,270	$201,420	$354,690	100.0 %
# of Trainees [per year]	:	/	75	75	75	
Cost per Trainee	:	=	$2,044	$2,686	$4,729	

Training Cost Analysis - On-location

Course Title :	Sample Course
Course Number :	123456

BASIC

Course Length [hours] :	45.0
Classroom Section of Course [hours] :	45.0
Number of Trainees [per class] :	15
Number of Instructors [per class] :	2.0
Frequency of Course [per year] :	5
% of Trainees that Travel :	80.0 %
% of Instructors that Travel :	100.0 %
Trainee Travel Length [days] :	1.00
Instructor Travel Length [days] :	2.00
Days Required by Trainee [per class] :	6.8
Days Required by Instructor [per class] :	8.0
Number of Trainees [per year] :	75.0
Number of Instructors [per year] :	10.0

Training Cost Analysis - On-location

TRAINEE

Trainee Annual Salary :		$50,000
Fringe Benefits Factor :	x	25.0 %
Annual Trainees Costs :	=	$62,500
Annual Productive Days :	/	222
Trainee Daily Salary :	=	$282
Lost Opportunity Costs :		$0
Trainee Per Diem :		$120
Trainee Travel Costs :		$200
Class Length [days] :		6.8
Total # of Trainees [per year] :		75

Annual Trainees Costs

. Salary :	$143,820

. Lost Opportunity	:	+	$0
. Per Diem	:	+	$50,400
. Travel	:	+	$12,000
Miscellaneous Costs	:	+	$0
Total Trainee Costs [per year]	:	=	$206,220

Training Cost Analysis - On-location

INSTRUCTOR

Instructor Annual Salary	:		$65,000
Fringe Benefits Factor	:	x	25.0 %
Annual Instructors Costs	:	=	$81,250
Annual Productive Days	:	/	222
Instructor Daily Salary	:	=	$366
Lost Opportunity Costs	:		$0
Instructor Per Diem	:		$120
Instructor Travel Costs	:		$1,000
Consulting Fees [per class]	:		$0
Class Length [days]	:		8.0
Total # of Instructors [per year]	:		10.0

Annual Instructors Costs			
. Salary	:		$29,280
. Lost Opportunity	:	+	$0
. Per Diem	:	+	$9,600
. Travel	:	+	$10,000
Miscellaneous Costs	:	+	$0
Total Instructor Costs [per year]	:	=	$48,880

Training Cost Analysis - On-location

DEVELOPMENT

	S M Expert	Clerical
Annual Salary :	$65,000	$28,000
Fringe Benefits :	25.0 %	25.0 %
Annual Cost :	$81,250	$35,000
Productive Days :	222	222
Daily Salary :	$366	$158
Days on Project :	50	2
Total Costs :	$18,300	$316

Total Personnel Costs :		$18,616
Contracting Costs :	+	$0
Production and Material Costs :	+	$1,000
Evaluation Costs :	+	$0
Miscellaneous Costs :	+	$4,000
Total Development Costs :	=	$23,616
Amortization :	/	3.0
Development Costs [per year] :	=	$7,872

Training Cost Analysis - On-location

FACILITIES

Annual Facilities Costs :		$0
Course Allocation [%] :	x	0.0 %
Facilities Cost for Course :	=	$0
Rental Fees [per class] :		$500
Total Facilities Costs [per year] :		$2,500

MAINTENANCE

Administrative		S M Expert
Annual Salary	:	$65,000
Fringe Benefits	:	25.0 %
Annual Cost	:	$81,250
Productive Days	:	222
Daily Salary	:	$366
Days on Project	:	6
Total Costs	:	$2,196
Total Administrative Costs	:	$2,196

Consumable Material

Course Material Costs [per trainee]	:		$20.0
Number of Trainees [per year]	:	x	75
Total Course Material Costs	:	=	$1,500
Miscellaneous Costs	:	+	$100
Total Material Costs	:	=	$1,600

Revision

Development Costs [per year]	:		$23,616
Revision Factor [per year]	:	x	10.0 %
Total Revision Costs [per year]	:	=	$2,362
Total Maintenance Costs	:		$6,158

Training Cost Analysis - On-location

HARDWARE

Equipment and Remodelling Costs	:		$0
Course Allocation	:	x	0.0 %
Equipment Cost for Course	:	=	$0
Expected Life of Equipment	:	/	3.0
Equipment Cost [per year]	:	=	$0

Training Cost Analysis - On-location

SUMMARY

	Total costs per year		Total savings per year		
	Classroom	On-location	Direct	Indirect	Total
Trainee Costs :	$316,200	$206,220	$84,600	$25,380	$109,980
Instructor Costs : +	$21,960	$48,880	($19,600)	($7,320)	($26,920)
Development Costs : +	$7,872	$7,872	$0	$0	$0
Facilities Costs : +	$2,500	$2,500	$0	$0	$0
Maintenance Costs : +	$6,158	$6,158	$0	$0	$0
Hardware Costs : +	$0	$0	$0	$0	$0
Training Costs :=	$354,690	$271,630	$65,000	$18,060	$83,060
Number of Trainees : /	75	75	75	75	75
Cost per Trainee :=	$4,729	$3,622	$867	$241	$1,108

Training Cost Analysis - Print

Course Title	:	Sample Course
Course Number	:	123456

BASIC

Course Length [hours]	:	45.0
Print Section of Course [hours]	:	45.0
Time Required by Trainee [% of classroom]	:	120.0 %
Time Required by Instructor [% of classroom]	:	20.0 %
% of Trainees that Travel	:	0.0 %
% of Instructors that Travel	:	0.0 %
Trainee Travel Length [days]	:	0.00
Instructor Travel Length [days]	:	0.00
Days Required by Trainee [per class]	:	7.2
Days Required by Instructor [per class]	:	1.2
Number of Trainees [per year]	:	75.0
Number of Instructors [per year]	:	10.0

Training Cost Analysis - Print

TRAINEE

Trainee Annual Salary	:		$50,000
Fringe Benefits Factor	:	x	25.0 %
Annual Trainees Costs	:	=	$62,500
Annual Productive Days	:	/	222
Trainee Daily Salary	:	=	$282
Lost Opportunity Costs	:		$0
Trainee Per Diem	:		$0
Trainee Travel Costs	:		$0

Class Length [days]	:		7.2
Total # of Trainees [per year]	:		75

Annual Trainees Costs			
. Salary	:		$152,280
. Lost Opportunity	:	+	$0
. Per Diem	:	+	$0
. Travel	:	+	$0
Miscellaneous Costs	:	+	$0
Total Trainee Costs [per year]	:	=	$152,280

INSTRUCTOR

Instructor Annual Salary	:		$65,000
Fringe Benefits Factor	:	x	25.0 %
Annual Instructors Costs	:	=	$81,250
Annual Productive Days	:	/	222
Instructor Daily Salary	:	=	$366
Lost Opportunity Costs	:		$0
Instructor Per Diem	:		$0
Instructor Travel Costs	:		$0
Consulting Fees [per class]	:		$0
Class Length [days]	:		1.2
Total # of Instructors [per year]	:		10.0
Annual Instructors Costs			
. Salary	:		$4,392
. Lost Opportunity	:	+	$0
. Per Diem	:	+	$0
. Travel	:	+	$0
Miscellaneous Costs	:	+	$0
Total Instructor Costs [per year]	:	=	$4,392

Training Cost Analysis - Print

DEVELOPMENT

Development Hours [per hour]	:		60
Total Development Time [days]	:		360
Average Daily Salary for Developer	:	x	400
Total Personnel Costs	:	=	$144,000

Development	:		In-house
Total Personnel Costs	:		$144,000
Master Copy Production Costs	:	+	$500
Evaluation Costs	:	+	$1,000
Miscellaneous Costs	:	+	$0
Contracting Costs	:	+	$0
Total Development Costs	:	=	$145,500
Amortization	:	/	3
Development Costs [per year]	:	=	$48,500

Training Cost Analysis - Print

FACILITIES

		Classroom	[%]	Print
Facilities	:	$2,500	0.0 %	$0
Total Costs	:	$2,500		$0

Training Cost Analysis - Print

MAINTENANCE

Administrative			S M Expert
Annual Salary	:		$65,000
Fringe Benefits	:		25.0 %
Annual Cost	:		$81,250
Productive Days	:		222
Daily Salary	:		$366
Days on Project	:		6
Total Costs	:		$2,196
Total Administrative Costs	:		$2,196

Consumable Material

Course Material Costs [per trainee]	:		$25.0
Number of Trainees [per year]	:	x	75
Total Course Material Costs	:	=	$1,875
Miscellaneous Costs	:	+	$1,000
Total Material Costs	:	=	$2,875

Revision

Development Costs	:		$145,500
Revision Factor [per year]	:	x	10.0 %
Total Revision Costs [per year]	:	=	$14,550
Total Maintenance Costs	:		$19,621

Training Cost Analysis - Print

HARDWARE

		Classroom	[%]	Print
Hardware	:	$0	0.0 %	$0
Total Costs	:	$0	$0	

Training Cost Analysis - Print

SUMMARY

		Total costs per year		Total savings per year		
		Classroom	Print	Direct	Indirect	Total
Trainee Costs :		$316,200	$152,280	$147,000	$16,920	$163,920
Instructor Costs :	+	$21,960	$4,392	$0	$17,568	$17,568
Development Costs :	+	$7,872	$48,500	$1,524	($42,152)	($40,628)
Facilities Costs :	+	$2,500	$0	$2,500	$0	$2,500
Maintenance Costs :	+	$6,158	$19,621	($818)	($12,645)	($13,463)
Hardware Costs :	+	$0	$0	$0	$0	$0
Training Costs :	=	$354,690	$224,793	$150,206	($20,309)	$129,897
Number of Trainees :	/	75	75	75	75	75
Cost per Trainee :	=	$4,729	$2,997	$2,003	($271)	$1,732

Training Cost Analysis - Tapes

Course Title	:	Sample Course
Course Number	:	123456

BASIC

Course Length [hours]	:	45.0
Taped Section of Course [hours]	:	45.0
Time Required by Trainee [% of classroom]	:	90.0 %
Time Required by Instructor [% of classroom]	:	20.0 %
% of Trainees that Travel	:	0.0 %
% of Instructors that Travel	:	0.0 %
Trainee Travel Length [days]	:	0.00
Instructor Travel Length [days]	:	0.00
Days Required by Trainee [per class]	:	5.4
Days Required by Instructor [per class]	:	1.2
Number of Trainees [per year]	:	75.0
Number of Instructors [per year]	:	10.0

Training Cost Analysis - Tapes

TRAINEE

Trainee Annual Salary	:		$50,000
Fringe Benefits Factor	:	x	25.0 %
Annual Trainees Costs	:	=	$62,500
Annual Productive Days	:	/	222
Trainee Daily Salary	:	=	$282
Lost Opportunity Costs	:		$0
Trainee Per Diem	:		$0
Trainee Travel Costs	:		$0
Class Length [days]	:		5.4
Total # of Trainees [per year]	:		75

Annual Trainees Costs

. Salary	:	$114,210

. Lost Opportunity	:	+	$0
. Per Diem	:	+	$0
. Travel	:	+	$0
Miscellaneous Costs	:	+	$0
Total Trainee Costs [per year]	:	=	$114,210

Training Cost Analysis - Tapes

INSTRUCTOR

Instructor Annual Salary	:		$65,000
Fringe Benefits Factor	:	x	25.0 %
Annual Instructors Costs	:	=	$81,250
Annual Productive Days	:	/	222
Instructor Daily Salary	:	=	$366
Lost Opportunity Costs	:		$0
Instructor Per Diem	:		$0
Instructor Travel Costs	:		$0
Consulting Fees [per class]	:		$0
Class Length [days]	:		1.2
Total # of Instructors [per year]	:		10.0

Annual Instructors Costs			
. Salary	:		$4,392
. Lost Opportunity	:	+	$0
. Per Diem	:	+	$0
. Travel	:	+	$0
Miscellaneous Costs	:	+	$0
Total Instructor Costs [per year]	:	=	$4,392

Training Cost Analysis - Tapes

DEVELOPMENT

Development Hours [per hour]	:		80
Total Development Time [days]	:		480
Average Daily Salary for Developer	:	x	600
Total Personnel Costs	:=		$288,000

Development	:		Consultant
Total Personnel Costs	:	.	$288,000
Master Copy Production Costs	:	+	$0
Evaluation Costs	:	+	$0
Miscellaneous Costs	:	+	$0
Contracting Costs	:	+	$0
Total Development Costs	:	=	$288,000
Amortization	:	/	3
Development Costs [per year]	:	=	$96,000

Training Cost Analysis - Tapes

FACILITIES

		Classroom	[%]	Tapes
Facilities	:	$2,500	0.0 %	$0
Total Costs	:	$2,500		$0

Training Cost Analysis - Tapes

MAINTENANCE

Administrative

		S M Expert
Annual Salary	:	$65,000
Fringe Benefits	:	25.0 %
Annual Cost	:	$81,250
Productive Days	:	222
Daily Salary	:	$366
Days on Project	:	6
Total Costs	:	$2,196
Total Administrative Costs	:	$2,196

Consumable Material

Course Material Costs [per trainee]	:		$25.0
Number of Trainees [per year]	:	x	75
Total Course Material Costs	:	=	$1,875
Miscellaneous Costs	:	+	$0
Total Material Costs	:	=	$1,875

Revision

Development Costs	:		$288,000
Revision Factor [per year]	:	x	10.0 %
Total Revision Costs [per year]	:	=	$28,800
Total Maintenance Costs	:		$32,871

Training Cost Analysis - Tapes

HARDWARE

Number of Tape Decks/VCRs Required	:		10
Cost per Tape Deck/VCR	:	x	$500
Total Hardware Costs	:	=	$5,000
Miscellaneous Costs	:	+	$1,000
Total Costs	:	=	$6,000
Course Allocation	:	x	15.0 %

Equipment Cost for Course	:	=	$900
Expected Life of Hardware	:	/	3
Hardware Cost [per year]	:	=	$300

Training Cost Analysis - Tapes

SUMMARY

		Total costs per year		Total savings per year		
		Classroom	Tapes	Direct	Indirect	Total
Trainee Costs :		$316,200	$114,210	$147,000	$54,990	$201,990
Instructor Costs :	+	$21,960	$4,392	$0	$17,568	$17,568
Development Costs :	+	$7,872	$96,000	($94,331)	$6,203	($88,128)
Facilities Costs :	+	$2,500	$0	$2,500	$0	$2,500
Maintenance Costs :	+	$6,158	$32,871	($28,574)	$1,861	($26,713)
Hardware Costs :	+	$0	$300	($300)	$0	($300)
Training Costs :	=	$354,690	$247,773	$26,295	$80,622	$106,917
Number of Trainees :	/	75	75	75	75	75
Cost per Trainee :	=	$4,729	$3,304	$351	$1,075	$1,426

Training Cost Analysis - Interactive

Course Title	:	Sample Course
Course Number	:	123456

BASIC

Course Length [hours]	:	45.0
Interactive Section of Course [hours]	:	45.0
Conducted in a computer lab with instructor	:	No
Number of Trainees [per class]	:	15
Number of Instructors [per class]	:	2.0
Frequency of Course [per year]	:	5
Time Required by Trainee [% of classroom]	:	70.0 %
Time Required by Instructor [% of classroom]	:	15.0 %
% of Trainees that Travel	:	0.0 %
% of Instructors that Travel	:	0.0 %
Trainee Travel Length [days]	:	0.00
Instructor Travel Length [days]	:	0.00
Days Required by Trainee [per class]	:	4.2
Days Required by Instructor [per class]	:	0.9
Number of Trainees [per year]	:	75.0
Number of Instructors [per year]	:	10.0

TRAINEE

Trainee Annual Salary	:		$50,000
Fringe Benefits Factor	:	x	25.0 %
Annual Trainees Costs	:	=	$62,500
Annual Productive Days	:	/	222
Trainee Daily Salary	:	=	$282
Lost Opportunity Costs	:		$0
Trainee Per Diem	:		$0
Trainee Travel Costs	:		$0
Class Length [days]	:		4.2
Total # of Trainees [per year]	:		75
Annual Trainees Costs			
. Salary	:		$88,830
. Lost Opportunity	:	+	$0
. Per Diem	:	+	$0
. Travel	:	+	$0
Miscellaneous Costs	:	+	$0
Total Trainee Costs [per year]	:	=	$88,830

INSTRUCTOR

Instructor Annual Salary	:		$65,000
Fringe Benefits Factor	:	x	25.0 %
Annual Instructors Costs	:	=	$81,250
Annual Productive Days	:	/	222
Instructor Daily Salary	:	=	$366
Lost Opportunity Costs	:		$0
Instructor Per Diem	:		$0
Instructor Travel Costs	:		$0
Consulting Fees [per class]	:		$0
Class Length [days]	:		0.9
Total # of Instructors [per year]	:		10.0
Annual Instructors Costs			
. Salary	:		$3,294
. Lost Opportunity	:	+	$0
. Per Diem	:	+	$0
. Travel	:	+	$0
Miscellaneous Costs	:	+	$0
Total Instructor Costs [per year]	:	=	$3,294

Training Cost Analysis - Interactive

DEVELOPMENT

Development Hours [per hour]	:		104
Length of CBT Course [hours]	:		32
Total Development Time [days]	:		437
Average Daily Salary for Developer	:	x	$700
Total Personnel Costs	:=		$305,900

Development	:		Consultant
Total Personnel Costs	:		$305,900
Master Copy Production Costs	:	+	$2,000
Evaluation Costs	:	+	$5,000
Miscellaneous Costs	:	+	$10,000
Contracting Costs	:	+	$0
Total Development Costs	:	=	$322,900
Amortization	:	/	3
Development Costs [per year]	:	=	$107,633

Training Cost Analysis - Interactive

FACILITIES

		Classroom	[%]	Interactive
Facilities	:	$2,500	0.0 %	$0
Total Costs	:	$2,500		$0

Training Cost Analysis - Interactive

MAINTENANCE

Administrative		S M Expert
Annual Salary	:	$65,000
Fringe Benefits	:	25.0 %
Annual Cost	:	$81,250

Productive Days	:		222
Daily Salary	:		$366
Days on Project	:		6
Total Costs	:		$2,196

Total Administrative Costs	:		$2,196

Consumable Material

Course Material Costs [per trainee]	:		$2.0
Number of Trainees [per year]	:	x	75
Total Course Material Costs	:	=	$150
Miscellaneous Costs	:	+	$0
Total Material Costs	:	=	$150

Revision

Development Costs	:		$322,900
Revision Factor [per year]	:	x	10.0 %
Total Revision Costs [per year]	:	=	$32,290

Total Maintenance Costs	:		$34,636

Training Cost Analysis - Interactive

HARDWARE

Number of Computers Required	:		10
Cost per Computer	:	x	$3,000
Total Hardware Costs	:	=	$30,000
Miscellaneous Costs	:	+	$1,000
Total Costs	:	=	$31,000
Course Allocation	:	x	15.0 %
Equipment Cost for Course	:	=	$4,650
Expected Life of Computer	:	/	3
Hardware Cost [per year]	:	=	$1,550

Training Cost Analysis - Interactive

SUMMARY

		Total costs per year		Total savings per year		
		Classroom	Interactive	Direct	Indirect	Total
Trainee Costs :		$316,200	$88,830	$147,000	$80,370	$227,370
Instructor Costs :	+	$21,960	$3,294	$0	$18,666	$18,666
Development Costs :	+	$7,872	$107,633	($104,350)	$4,589	($99,761)
Facilities Costs :	+	$2,500	$0	$2,500	$0	$2,500
Maintenance Costs :	+	$6,158	$34,636	($29,855)	$1,377	($28,478)
Hardware Costs :	+	$0	$1,550	($1,550)	$0	($1,550)
Training Costs :	=	$354,690	$235,943	$13,745	$105,002	$118,747
Number of Trainees :	/	75	75	75	75	75
Cost per Trainee :	=	$4,729	$3,146	$183	$1,400	$1,583

Training Cost Analysis - Distance

Course Title	:	Sample Course
Course Number	:	123456

BASIC

Course Length [hours]	:	45.0
Distance Section of Course [hours]	:	45.0
Number of Trainees [per class]	:	15
Number of Instructors [per class]	:	2.0
Frequency of Course [per year]	:	5
Time Required by Trainee [% of classroom]	:	100.0 %
Time Required by Instructor [% of classroom]	:	100.0 %
% of Trainees that Travel	:	0.0 %
% of Instructors that Travel	:	0.0 %
Trainee Travel Length [days]	:	0.00
Instructor Travel Length [days]	:	0.00
Days Required by Trainee [per class]	:	6.0
Days Required by Instructor [per class]	:	6.0
Number of Trainees [per year]	:	75.0
Number of Instructors [per year]	:	10.0

Training Cost Analysis - Distance

TRAINEE

Trainee Annual Salary	:		$50,000
Fringe Benefits Factor	:	x	25.0 %
Annual Trainees Costs	:	=	$62,500
Annual Productive Days	:	/	222
Trainee Daily Salary	:	=	$282
Lost Opportunity Costs	:		$0
Trainee Per Diem	:		$0
Trainee Travel Costs	:		$0
Class Length [days]	:		6.0
Total # of Trainees [per year]	:		75
Annual Trainees Costs			
. Salary	:		$126,900
. Lost Opportunity	:	+	$0
. Per Diem	:	+	$0
. Travel	:	+	$0
Miscellaneous Costs	:	+	$0
Total Trainee Costs [per year]	:	=	$126,900

INSTRUCTOR

Instructor Annual Salary	:		$65,000
Fringe Benefits Factor	:	x	25.0 %
Annual Instructors Costs	:	=	$81,250
Annual Productive Days	:	/	222
Instructor Daily Salary	:	=	$366
Lost Opportunity Costs	:		$0
Instructor Per Diem	:		$0
Instructor Travel Costs	:		$0
Consulting Fees [per class]	:		$0
Class Length [days]	:		6.0
Total # of Instructors [per year]	:		10.0
Annual Instructors Costs			
. Salary	:		$21,960
. Lost Opportunity	:	+	$0
. Per Diem	:	+	$0
. Travel	:	+	$0
Miscellaneous Costs	:	+	$0
Total Instructor Costs [per year]	:	=	$21,960

Training Cost Analysis - Distance

DEVELOPMENT

Development Hours [per hour]	:		60
Total Development Time [days]	:		360
Average Daily Salary for Developer	:	x	400
Total Personnel Costs	:	=	$144,000

Development	:		In-house
Total Personnel Costs	:		$144,000
Master Copy Production Costs	:	+	$1,000
Evaluation Costs	:	+	$0
Miscellaneous Costs	:	+	$4,000
Contracting Costs	:	+	$0
Total Development Costs	:	=	$149,000
Amortization	:	/	3
Development Costs [per year]	:	=	$49,667

Training Cost Analysis - Distance

FACILITIES

		Classroom	[%]	Distance
Facilities	:	$2,500	200.0 %	$5,000
Total Costs	:	$2,500		$5,000

MAINTENANCE

Administrative

		S M Expert
Annual Salary :		$65,000
Fringe Benefits :		25.0 %
Annual Cost :		$81,250
Productive Days :		222
Daily Salary :		$366
Days on Project :		6
Total Costs :		$2,196
Total Administrative Costs :		$2,196

Transmission Cost

Connecting Charges [per line/mth.] :		$45
Total Connecting Charges [per yr.] :		$8,640
Course Allocation :	x	15.0 %
Connecting Charges for Course :	=	$1,296
# of Sites Connected at a Time :		4
# of Audio Lines [per site] :		1
# of Video Lines [per site] :		3
Audio Transmission Costs [per hour] :		$9.0
Video Transmission Costs [per hour] :		$9.0
Transmission Cost [per class] :		$6,480
Cost of Bridge [per class] :	+	$3,240
Miscellaneous Costs :	+	$0
Total Transmission Costs [per class] :	=	$9,720
Total Transmission Costs [per year] :		$48,600

Revision

Development Costs :		$149,000
Revision Factor [per year] :	x	10.0 %
Total Revision Costs [per year] :	=	$14,900
Total Maintenance Costs :		$66,992

Training Cost Analysis - Distance

HARDWARE

Number of Sites	:		10
Equipment Cost	:	x	$16,000
Total Hardware Costs	:	=	$160,000
Miscellaneous Costs	:	+	$30,000
Total Costs	:	=	$190,000
Course Allocation	:	x	15.0 %
Equipment Cost for Course	:	=	$28,500
Expected Life of Hardware	:	/	3
Hardware Cost [per year]	:	=	$9,500

Training Cost Analysis - Distance

SUMMARY

		Total costs per year		Total savings per year		
		Classroom	Distance	Direct	Indirect	Total
Trainee Costs :		$316,200	$126,900	$147,000	$42,300	$189,300
Instructor Costs :	+	$21,960	$21,960	$0	$0	$0
Development Costs :	+	$7,872	$49,667	($20)	($41,775)	($41,795)
Facilities Costs :	+	$2,500	$5,000	($2,500)	$0	($2,500)
Maintenance Costs :	+	$6,158	$66,992	($48,302)	($12,532)	($60,834)
Hardware Costs :	+	$0	$9,500	($9,500)	$0	($9,500)
Training Costs :	=	$354,690	$280,019	$86,678	($12,007)	$74,671
Number of Trainees :	/	75	75	75	75	75
Cost per Trainee :	=	$4,729	$3,734	$1,156	($160)	$996

Training Cost Analysis - Summary

Course Title	:	Sample Course
Course Number	:	123456

COSTS

		Classroom	On-location	Print	Tapes	Interactive	Distance
Trainees :		$316,200	$206,220	$152,280	$114,210	$88,830	$126,900
Instructors :	+	$21,960	$48,880	$4,392	$4,392	$3,294	$21,960
Development :	+	$7,872	$7,872	$48,500	$96,000	$107,633	$49,667
Facilities :	+	$2,500	$2,500	$0	$0	$0	$5,000
Maintenance :	+	$6,158	$6,158	$19,621	$32,871	$34,636	$66,992
Hardware :	+	$0	$0	$0	$300	$1,550	$9,500
Total Costs :	+	$354,690	$271,630	$224,793	$247,773	$235,943	$280,019
Trainees :	/	$75	75	75	75	75	75
Per Trainee :	+	$4,729	$3,622	$2,997	$3,304	$3,146	$3,734

Training Cost Analysis - Summary

SAVINGS

	On-location	Print	Tapes	Interactive	Distance
Direct Savings :	$65,000	$150,206	$26,295	$13,745	$86,678
Indirect Savings : +	$18,060	($20,309)	$80,622	$105,002	($12,007)
Total Savings : =	$83,060	$129,897	$106,917	$118,747	$74,671
Savings over Life :	$249,180	$389,691	$320,751	$356,241	$224,013

Training Cost Analysis - Summary

INVESTMENT

	Classroom	On-location	Print	Tapes	Interactive	Distance
Development :	$23,616	$23,616	$145,500	$288,000	$322,900	$149,000
Hardware : +	$0	$0	$0	$900	$4,650	$28,500
Investment : =	$23,616	$23,616	$145,500	$288,900	$327,550	$177,500

Training Cost Analysis - Summary

BREAK EVEN POINT [months]

	On-location	Print	Tapes	Interactive	Distance
Break Even Point :	0	9	17	17	15

INITIAL DISTRIBUTION LIST

Number of Copies

1. Defense Technical Information Center..2
   8725 John J. Klingman Rd., STE 0944
   Ft Belvoir, VA 22060-6218

2. Dudley Knox Library...2
   Naval Postgraduate School
   411 Dyer Rd.
   Monterey, CA 93943-5101

3. Director, Training and Education...1
   MCCDC, Code C46
   1019 Elliot Road
   Quantico, VA 22134-5027

4. Director, Marine Corps Research Center...2
   MCCDC, Code C40RC
   2040 Broadway Street
   Quantico, VA 22134-5107

5. Director, Studies and Analysis Division
   MCCDC, Code C45
   3300 Russell Road
   Quantico, VA 22134-5130

6. Marine Corps Representative (037)..2
   Bldg. 234, HA-220
   Naval Postgraduate School
   699 Dyer Road
   Monterey, CA 93943

7. Marine Corps Tactical Systems Support Activity...1
   Technical Advisory Branch
   Attn: Maj J.C. Cummiskey
   Box 444171
   Camp Pendleton, CA 92055-5080

8. Curricular Officer, Code 36 1
Department of Systems Management
Naval Postgraduate School
Monterey, CA 93943-5002

9. Professor Alice Crawford, Code SM/Cr 2
Department of Systems Management
Naval Postgraduate School
Monterey, CA 93943-5002

10. Professor Hemant Bhargava, Code SM/Bh 1
Department of Systems Management
Naval Postgraduate School
Monterey, CA 93943-5002

11. Carl Jones, Code SM/Js 1
Department of Systems Management
Naval Postgraduate School
Monterey, CA 93943-5002

12. Major M. G. Broihier 2
652 Hoffman Avenue
Monterey, CA 93940